ASCENT MAX® DUCTLESS FUME CABINET

USER & SERVICE MANUAL

Esco ADC Manual Version 3.2 / Released 11 May 2007
Specifications subject to change without notice

WELCOME NOTE FROM ESCO

Congratulations! You have just purchased one of the finest ductless fume cabinets available.

It is a pleasure to welcome you to the exclusive club of our growing number of customers who, over the years have come to not just own and operate their Esco fume cabinets but treasure them too. For your convenience all exposed exterior and interior surfaces of this product has been wiped in a controlled clean environment. Protective coverings on stainless steel and plastic surfaces, wherever present, have also been removed.

Your new Esco Ductless Fume cabinet now comes with a whole range of unique features and exciting new improvisations to simplify maintenance, enhance safety and improve ergonomics. These include:

- *New user-friendly Sentinel™ microprocessor-based control and alarm system which simplifies operation and enhances user safety*
- *All-metal carcass which create an air-tight out shell for the best possible toxic fume containment possible*
- *Single piece stainless steel work tray and work zone liner for ease in cleaning*
- *5000k fluorescent lamps providing work zone lighting of intensity greater than 1000 lux / 94 foot candles under normal lab lightning condition for greater comfort and minimal glare*

Please read this manual to familiarize yourself with the procedures involved in the installation, basic operation and maintenance of the cabinet.

We recommend that this manual, together with the factory test report, be kept near the cabinet for convenient reference by operators and qualified maintenance personnel. If you have any questions that are not addressed in this manual, please do not hesitate to reach us by e-mail at ductless@escoglobal.com or give us a call at +65 65420833.

With warm regards from Singapore,

Lim Lay Yew
Chief Executive Officer

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Visit our website at ductless.escoglobal.com

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SAFETY WARNING

- The use of any hazardous material in the cabinet must be monitored by an industrial hygienist, safety officer or some other suitably qualified individual.
- Explosive or inflammable substances should never be used in the cabinet unless a qualified safety professional has evaluated the risk involved.
- If radiological hazards are being used in the cabinet, additional protective measures should be taken. Besides that, the operation should be monitored by a suitably trained individual.
- Before you proceed, you should thoroughly understand the installation procedures and take note of the environmental/electrical requirements of the cabinet
- In this manual, important safety related points will be marked with this symbol.
- If the equipment is used in a manner not specified by this manual, the protection provided by this equipment may be impaired.

LIMITATION OF LIABILITY

The disposal and / or emission of substances used in connection with this cabinet may be governed by various local regulations. Familiarization and compliance with any such regulation are the sole responsibility of the users of the cabinet. Esco's liability is limited with respect to user compliance with such regulations.

European Union Directive on WEEE and RoHS

The European Union has recently issued two directives: Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE) and Directive 2002/95/EC on Restriction on the use of Hazardous Substances (RoHS).

WEEE: The objective of the WEEE directive is to promote "….*the reuse, recycling and other forms of recovery of such wastes (WEEE) so as to reduce the disposal of waste besides improving the environmental performance of all operators involved in the life cycle of electrical and electronic equipment, e.g. producers, distributors and consumers….*" and hence this directive is relevant to the issue of disposal of this cabinet within the EU. As per this directive, a "wheelie bin" sticker (shown alongside) has to be pasted on all products which come under the purview of this directive, thereby indicating that at the time of disposing the particular product/equipment, it should not be grouped together with general unsorted municipal waste. Instead the directive mandates that distributors of electrical and electronic equipments be responsible for the collection and scrapping of the products they have sold. Please note that this cabinet has been classified as **"fixed industrial equipment"** and hence does **NOT** come under the purview of the WEEE directive. At the time of disposing this cabinet, you can still contact your local Esco distributor who would arrange for collection and recycling of this cabinet at a reasonable fee.

RoHS: With respect to the directive on RoHS, please note that this cabinet falls under category 9 (monitoring and control instruments) and is therefore **EXEMPTED** from requirement to comply with the provisions of this directive.

Declaration of Conformity *

In accordance with EN 45014:1998

CE

We, **Esco Micro Pte Ltd**
based at 21 Changi South Street 1
SINGAPORE 486777
Tel: +65 65420833
Fax: +65 65426920

declare on our sole responsibility that the product:

Equipment : Ductless Fume Cabinets
Model : Esco Ascent Max™ Ductless Fume Cabinet (ADC-3BX, ADC-4BX, ADC-5BX, ADC-6BX)

in accordance with the following directives:

- **72/23/EEC : The Low Voltage Directive and its amending directives**
- **89/336/EEC : The Electromagnetic Compatibility Directive and its amending directives**

has been designed to comply with the requirements of the following Harmonized Standard:

- **Safety Standard : EN 61010-1 (2001)**
- **EMC : EN 61326 (2002) Class B**
- **Design/Performance Criteria:**
  - **ANSI / ASHRAE 110-1995**
  - **British Standard 7258:2001**
  - **British Standard 7989:2001**
  - **AFNOR NF X 15-203**
  - **AFNOR NF X 15-211**
  - **AS/NZ Standard 2243.9:2003**
  - **European Union Standard EN 14175-3**

More information may be obtained from Esco's authorized distributors located within the EU. A list of these parties and their necessary contact information is available on request from Esco.

Lim Lay Yew
Chief Executive Officer

* Applicable only to 220-240 VAC 50 Hz cabinets

FREIGHT CLAIM INFORMATION

Esco inspects each product for defects before shipment. Esco products are then carefully packed in compliance with carrier regulations and thoroughly inspected before leaving our plant. Responsibility for their safe delivery is assumed by the carrier upon acceptance of the shipment. However shipments occasionally do get damaged in transit. Claims for loss or damages sustained in transit must be made upon the carrier.

Please note that for each shipment you accept, you would be responsible for all freight claims and the cost of replacement of all damaged parts/items. So please inspect each shipment very carefully before accepting.

Carefully inspect each pallet or crate upon receipt. If a shipment is found to be damaged upon delivery, you are required to get the driver / carrier take note of the details of the damage on the delivery receipt. This is very important as your claim may be rejected otherwise. In case the pallets are found to be stacked, please leave a note saying "Stacked Pallets" on the delivery receipt. Note that pallets are not stacked at the time of being shipped out of our premises, unless otherwise stated for certain products. Esco is not responsible for pallets being stacked at carrier terminal. Any unloading difficulties or damages due to components being stacked are the responsibility of the carrier.

If freight damage is discovered, please refer to the following guidelines for effective processing of freight claim:

SHIPMENT WITH VISIBLE LOSS OR DAMAGE

- Any external evidence of loss or damage must be noted on the freight bill or delivery receipt and signed by the courier's agent or delivery driver
  NB: Failure to properly describe evidence of loss or damage may result in the carrier refusing to honour a claim
- Contact delivering terminal to arrange for a claim form and inspection report to be faxed or mailed to you
- Notify Esco Micro Pte Ltd regarding the items/parts that need to be replaced
- Keep all damaged items/parts and packaging material until claim is resolved between you and the carrier

SHIPMENT WITH CONCEALED LOSS OR DAMAGE

When any damage or loss is discovered during the course of unpacking:

- Contact the carrier immediately upon discovery of damage and request for inspection by the carrier's agent.
- Carrier will determine the need for inspection based on the value of the shipment and time elapsed
- Notify Esco Micro Pte Ltd regarding the items/parts that need to be replaced
- For claim purposes, Esco will fax to you an order acknowledgment that would include the prices of the damaged items (less freight cost)
- Esco will invoice you for replacement items/parts
- Esco standard payment terms will apply

REJECTION OF SHIPMENT

- If a shipment is received with substantial damages, you may refuse to accept the shipment in part or full. Do not unpack pallets or crates with damaged materials. Please note that individual items cannot be refused. You can either reject the entire pallet or accept the freight after noting down the damages (see above)

- Esco will handle all freight claim procedures and process a replacement order for your company for the damaged items/parts at no extra charge. (This is applicable only if the original order was shipped under CIF terms i.e. Esco had covered the insurance)

NOTE: Any correspondence with Esco regarding loss or damage must be accompanied by a copy of the shipping carrier's report. Esco will not accept returns that have not been authorized.

In the event of you accepting a damaged shipment, notification of loss or damage must be sent to the carrier within 10 days of receiving the freight. Notification outside the 10-day time frame may result in shipping damage claim being rejected.

WARRANTY TERMS AND CONDITIONS

Esco warrants that this equipment will perform according to the specifications for 1 years from the date of purchase. With certain exceptions***,** this 1 years warranty applies to all parts and components of this equipment

Esco's liability under this warranty shall be limited to repair or replacement of the equipment at Esco's option. Under no circumstances shall Esco be liable for the equipment damage arising out of or in any way connected with the failure of the equipment to perform as set forth herein. This limited warranty is in lieu of all other expressed or implied warranties, including those of merchantability and fitness for a particular purpose.

In the event of any defect, malfunction or breakdown being detected during the warranty period, Esco will repair or replace, at its option, the product or component therein which upon examination by Esco shall appear to be defective, or not up to factory specifications. The purchaser must pay any transportation or labour expenses incurred in removing and returning the product to the service centre.

Esco would not be responsible for the cabinet's malfunctioning or any sort of damage to people or property arising out of non-compliance with the operating instructions laid down in this manual, poor maintenance or improper use of the cabinet.

This warranty shall not apply to any Esco product or part thereof which has been subject to misuse, abuse, accident, shipping damage, improper installation, unauthorized servicing and testing, damage by fire / flood, or acts of God. If the serial number of this product is altered, removed or defaced as to be illegible, the warranty shall be null and void in its entirety.

The use of non-Esco parts and/or parts not supplied directly by Esco or our authorized distributors, including but not limited to maintenance parts, spare parts, replacement parts, system components and/or system accessories, shall void all expressed or implied warranties.

To obtain warranty service, the defective product or part(s) must be returned to Esco or an authorized Esco Factory Service Centre along with a proof of purchase. ***It is mandatory for the customers to register receipt of their equipment online with Esco at http://www.escoglobal.com/warranty. Alternatively, the user can also complete the warranty registration form which can be found within this manual.***

Please take note that when returning the defective product or part(s), you must first obtain a return authorization (RA) number from Esco and it must be noted on the documents accompanying the return. **The defect reporting form can be found in this manual**.

** The 1 year warranty doesn't apply to consumable parts viz. filter, light tubes, pre-filters.*

CORPORATE PROFILE – FUME FILTRATION DIVISION

A History of Clean Air Device Manufacturing

The emergence of new high-tech industrial and life sciences industries in the late 70's opened opportunities for development of clean air solutions. We were among the earliest to spot this opportunity. Esco was thus founded in 1978 to pioneer development in this exciting new field of clean air technologies. Soon after, leveraging on our strengths in clean air technology, we ventured into the construction of laminar flow clean air devices.

By the early 80's, we had already designed biohazard safety cabinets - today a core offering of Esco Biotech - and fume hoods. Manufacturing of these products were also undertaken simultaneously. This greatly helped us in broadening the base of our core competencies to encompass containment technology. By then, Esco had emerged as the first local company to export indigenously developed and credible clean air products. To further build on our strengths, Esco established a sheet metal fabrication facility in 1985.

Esco Fume Filtration

The Esco Fume Filtration Division is a highly focused manufacturer of ductless fume cabinets and other carbon-filtered enclosures designed for the containment of hazardous chemical vapours in the laboratory.

Our products comply with the latest international standards for both containment and filtration efficacy such as the American Standard ASHRAE 110, European Standard EN 14175, French Standard AFNOR NF X 15-211 and British Standard BS 7989:2001. Esco is unique in being the first and only Asian manufacturer of carbon filtered enclosures which have been independently tested and certified. Our state-of-the-art in house testing capabilities for both containment and filtration efficacy have also been independently accredited.

Esco offers one of the widest ranges (more than 7 types) of carbon filtered enclosures in the industry and are carefully matched to the user's application to ensure safety. When this process is complete, the user can enjoy the benefits of carbon filtration (ductless) technology including mobility, energy-savings and no installation costs.

Today Esco is helping a whole gamut of high-tech industries keep their products, people and processes free from contamination.

Be it our cleanroom construction components that help pharmaceutical majors meet GMP standards for producing drugs in a clean environment; or our laminar flow mini-environments that help microelectronics manufacturers enhance their product reliability and yields; or for that matter our safety cabinets that help researchers conducting clinical biological research in developing vaccines for dangerous diseases – Esco is making its own humble contribution in a wide range of critical fields that in turn help in making a difference to our day-to-day lives.

With sales in over 70 countries, we have fully geared ourselves for the international marketplace. In our single minded pursuit for customer satisfaction, we have developed a well knit network of international distributors and partners who provide quick, responsive and localised service and support for our products.

Sophisticated Production Capabilities

Today Esco's production work is carried out at a state-of-the-art centralized facility measuring 3,900 m^2 (42,000 sq. ft). Based in Bintan, Indonesian, this facility is highly automated to ensure that all products adhere to the highest quality standards and production involves minimal human intervention. CNC (Computer Numerically Controlled) sheet metal machinery is the pride of the facility. An advanced powder-coating process has also been incorporated in the facility to provide an aesthetic finish to all the laboratory equipment produced at the facility. We have always been careful not to sit complacently on our laurels and are strongly committed to continuously investing in cutting edge of fabrication technologies.

World-Class R & D

At Esco, we understand that being at the cutting edge of technology is the key to our survival. Hence continuous investment in Research and Development (R&D) is the mainstay of our corporate policy. Currently, one in every two non-production staff at Esco serves in a R&D position. This is a further demonstration of how seriously we take our R&D.

Most of our R&D is carried out at the *Esco Fume Filtration Technology Centre* located at our corporate headquarters in Singapore.

This centre features a demonstration laboratory, conference/training facilities for visitors, and various testing laboratories in which state-of-the-art research and tests are continuously conducted in order to improve the performance of our products. The laboratories are equipped with a formidable array of latest instruments - properly calibrated and maintained. Included among them are particle counters, air velocity meters, flow visualization devices, electrical safety analysers, and light/noise level/vibration meters.

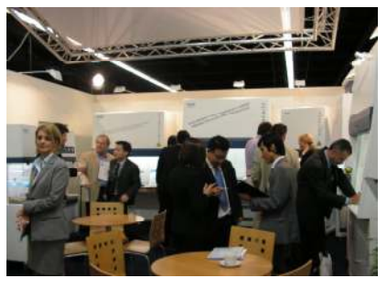
ISO 9001 Quality Management System

At Esco, quality and customer satisfaction are our top priorities, which is why the company operates under an ISO 9001 certified quality management system. Extensive quality control and testing, carried out at every stage ensures that we deliver nothing but the best to our customers.

ISO 14001 Environmental Management System

Esco also practices responsible corporate citizenship by demonstrating a firm commitment to the environment. Many of our products are designed to be extremely energy efficient, while our cabinets are produced using easily recyclable steel.

Geared for Global Marketplace



Esco regularly participates in numerous major international, regional and national industry trade shows and exhibitions.

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USER SECTION

CHAPTER I

BASIC PRODUCT INFORMATION

Ductless fume cabinets provide operator protection by removing chemical fume contaminants within the work area. They are suitable for most common chemical work (Note that ductless fume cabinets are NOT suitable for all chemical application. Please consult Esco for advice concerning your individual application). The Esco Ascent Max Ductless Fume Cabinet is our new-improved product which offers the best combination of performance, quality and cost-effective in the market today.

1.1 BACKGROUND

Conventional ducted fume hoods provide safety to laboratory personnel by drawing air across a front opening in the hood at a controlled rate, thus preventing any toxic vapours generated during the experimental procedure from escaping into the general laboratory environment.

Air is then exhausted via a fan system to the outside of the laboratory, usually via an outlet mounted on the root of the building. When released to the external atmosphere in this manner, chemical fumes and vapours, which would have otherwise been toxic in the enclosed environment of the laboratory, are diluted many times over and have an insignificant effect on the environment.

Ductless fume cabinets are quickly becoming a viable alternative to conventional fume hoods. Unlike conventional fume hoods, these cabinets filter out chemical fumes and recycle air directly back to the laboratory. Personnel protection is provided in a manner similar to conventional fume hoods by drawing air at a controlled rate across a front opening into the hood. Ductless fume cabinets have many advantages over conventional fume hoods:

- They protect the environment since toxic fumes are not released to the environment unlike in the conventional fume hoods.
- Fully installed systems ready to operate are available at a lower cost than bulky conventional fume hoods.
- An expensive ducting and external blower system that is often difficult to maintain is not required.
- They are mobile and can be relocated easily to meet your changing needs; perfect for schools and education institutes.
- They allow energy saving since air which is costly to air condition or heat is not removed from the laboratory.

In order to gain a better understanding of their benefits, let us examine how these hoods filter out chemical fumes generated during experimental procedures conducted in the laboratory. Esco's ductless fume cabinet incorporate a state-of-the-art vapour phase activated carbon filter system, which is the primary filtration component in removing all chemical fumes from within the hood before air is re-circulated back to the laboratory.

Activated carbon is a porous material manufactured from carbon-based raw materials. There include coal, peat, coconut and wood. The activated process develops pores of molecular dimension within the carbon particles. These give the carbon an extremely high internal porosity and surface areas. Typically, activated carbons contain surface area in the range of 500-2000 m^2/g.

The basic mechanism through which activated carbon removes impurities from contaminated air saturated with chemical fumes is referred to as physical adsorption. Physical adsorption is a phenomenon resulting from electrostatic forces of attraction (van der Waal forces) between the impurities and the internal surfaces of the activated carbon. Activated carbon has the strongest physical adsorption forces or the highest volume of adsorbing porosity of any material known to mankind.

The safety of personnel in the laboratory has always been of significant importance. Similarly it is important to consider the factors affecting the efficiency of activated carbon filtration in order to ascertain the ability of the technology to provide a safe solution in the laboratory.

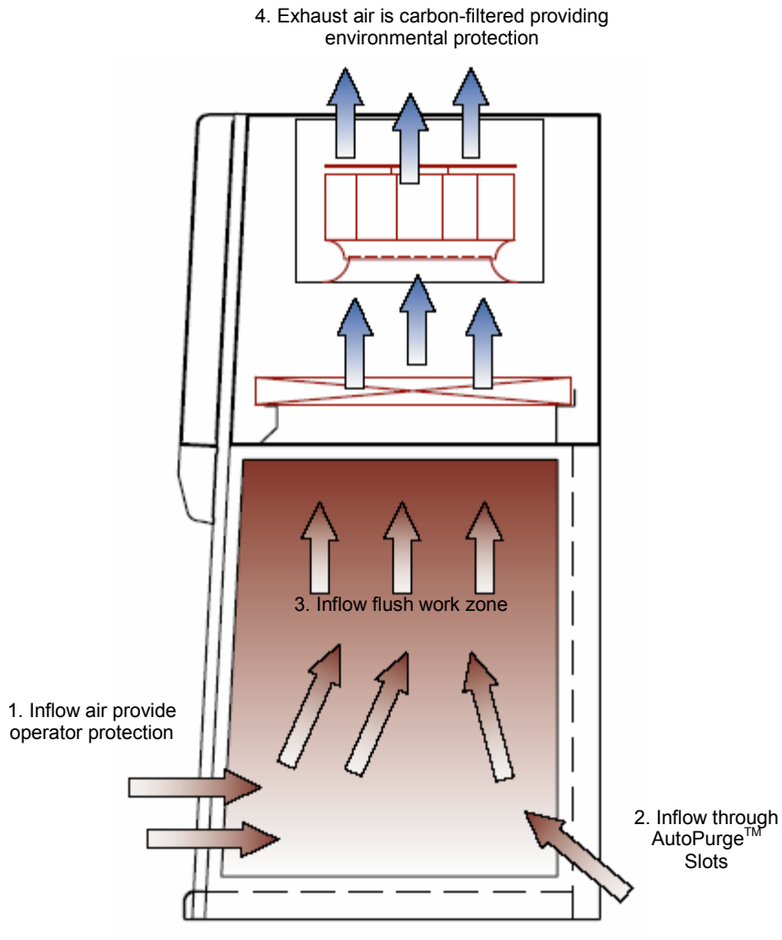
Activated carbon filter are suitable for use with many chemicals but this is dependent on a number of factor. In general, chemicals with a relative molecular weight over 30 and a boiling point higher than 60°C or 140°F can be adsorbed with a relatively high efficiency by activated carbon filtration.

Further variable include the amount of vapours being generated in the hood either through general evaporation or as a direct result of experimental procedures. Naturally, the lower the concentration of the chemical or the amount released in the hood in vapour form, the lower the safety risk to personnel. Other factors involving the nature of the chemical(s) used in the fume hood play a role. For example, larger molecules are adsorbed more easily by activated carbon. In addition, less soluble compounds are absorbed more easily than more soluble compounds. In the case of organic compounds branch-chain organics are more easily adsorbed than straight-chain organics.

Environmental factors may also affect the adsorptive efficiency of the hood. The ambient temperature of the laboratory and the gas must be kept to a minimum. The higher the ambient temperature the lower the adsorptive efficiency of the carbon filters. Relative humidity must also be kept to a minimum since an especially high relative humidity can cause the activated carbon filter to adsorbed water molecules in the place of chemical vapours.

The construction of the filter also affects the adsorption efficiency of the hood. A filter with a thicker media bed will have a longer contact time in which a larger amount of chemical vapour will be deposited in the filter by physical absorption.

1.2 AIRFLOW PATTERN INSIDE THE CABINET


4. Exhaust air is carbon-filtered providing environmental protection
3. Inflow flush work zone
1. Inflow air provide operator protection
2. Inflow through AutoPurge™ Slots

1. An inflow air curtain from the ambient environment into the cabinet with an average velocity of 0.5 m/s or 100 fpm is induced by the cabinet blower system.

2. Additional inflow air taken through the AutoPurge™ slots at the back of the work zone prevents fume accumulation for better operator protection.

3. The inflow flushes the entire work zone of the cabinet; within the main chamber of the cabinet, negative pressure (relative to the ambient environment) is maintained in order to ensure that no chemical fumes or vapours escape the work zone.

4. Air is taken through an activated carbon filter mounted in the interior; this removes all fumes from the exhaust air stream; exhaust air is recirculated directly back to the room from the top of the cabinet.

1.3 SAFETY

At Esco, your safety is of paramount importance to us. Thus Esco Ascent Max Ductless Fume cabinet has been packed with features that would take your safety to an altogether new level. A highlight of these features is as follows:

- All-metal carcass which creates an air-tight outer shell for the best possible toxic fume containment possible.
- Higher volumetric airflow rates from front and back (AutoPurge™) mean a larger number of air changes in the work zone and thus a higher degree of protection for the user.
- Frameless glass sliding sash front window construction which is more air-tight than conventional plastic systems.
- Audible and visual alarms alert the operator of unsafe sash positions (standard) and unsafe chemical concentration level in the exhaust (only on Ascent Max with VOC sensor)
- Red colour-coded access panels to electrical system and filter/blower internal plenum caution users of potentially dangerous/contaminated parts.
- Automatic pre-purge and post purge cycles ensure correct cabinet operation and operator safety.
- Electro galvanized steel sheets used in the outer shell of the cabinets lend enhanced rust resistant properties.

1.4 PERFORMANCE

The cabinet is precisely engineered to deliver the required performance anytime you need it

- As the filter loads, the intelligent blower system automatically adjusts itself to maintain constant airflow. This unique feature eliminates the need for constant speed control adjustments, thereby ensuring optimum performance
- Sentinel microprocessor control system monitors all critical cabinet airflow parameters and alerts the operator through audible/visual alarms in case of any malfunction. Airflow sensors employed are temperature-compensated
- Temperature compensation leads to improved accuracy of airflow sensor.

1.5 CLEANABILITY

The issue of cleanability is important to ensure easy procedures

- Raised-platform at the front of work area to retain spills for easy cleaning.
- The frameless glass sliding sash front window allows easy cleaning and prevent particle build-up between the frames in addition to providing a superior containment against leakages.

1.6 OPERATOR COMFORT

The features incorporated in this cabinet allow for greater operator comfort and better working condition:

- Motorised sash control for ease of use.
- Tempered glass sliding front sash is easier to operate as compared to the usual hinged designs (sash can also be shut fully to isolate the work zone when the cabinet is not in use).

- Ergonomically sloped front design for greater operator comfort, while the front control panel is downward-sloping for easier view of and access to the microprocessor control buttons.
- 5000k fluorescent lamp provides 1000 lux of work zone lighting for greater operator comfort and lessened glare.
- Electronic ballast for fluorescent lighting results in lower heat output, higher energy efficiency, increased reliability / service life and most importantly zero-flicker.
- Service fixture (optional) offset and staggered for easier reach and access

1.7 EASY SERVICING

We design the cabinets in such a way that the number of people required for servicing them is minimal, besides ensuring that the downtime is as short as possible.

- Easy filter access through the front part of the cabinet for minimized downtime
- Lifting grip position for filter and blower maintenance on front cover access
- Each cabinet is supplied with a convenient hand tool kit and extra fasteners.
- Blower Hour Meter to help the user monitor total cabinet usage. Every 60 hours, the control system reminds the user to test the exhaust concentration with gas detection tube to see whether the filter is saturated.

1.8 COST SAVING

Esco uses the permanently lubricated direct drive centrifugal blowers which employ an energy-efficient external rotor type design. This helps Esco cabinets deliver excellent performance while keeping the operating cost low at the same time.

1.9 TESTING

Before being shipped, each individual unit is extensively tested for performance and safety and delivered with a detailed test report and certificate of performance. Testing performed at our factory laboratory includes:

- Operator comfort tests: noise, light, vibration
- Filter efficiency
- Electrical safety to IEC61010-1

Additional units are also randomly selected on a statistical sampling basis and re-tested using research-grade instrumentation and additional test protocols at our dedicated Product Development Laboratory.

Esco performs testing in accordance with more than 20 of the world's most recognized standards of local, regional and international scopes. In particular, testing in our laboratory is most frequently conducted based on:

- ANSI/AIHA Z9.7: 1998. Recirculation of Air from Industrial Process Exhaust System
- AFNOR NF X 15-211. Ductless fume enclosures
- AS2243.9: 2003. Safety in laboratories - recirculating fume cabinets
- BS7989: 2001. Recirculating fume cupboards

- EN 14175. European fume cupboard standards.

1.10 INDEPENDENT TYPE CERTIFICATION

1. The Esco Ductless Fume Cabinet has been certified by an independent organization for compliance with ASHRAE 110-1995 requirements.

2. The Esco Ductless Fume Cabinet has been certified by an independent organization for compliance with BS 7258: 2001 requirements.

3. The Esco Ductless Fume Cabinet has been certified by an independent organization for compliance with BS 7989: 2001 requirements.

4. The Esco Ductless Fume Cabinet has been certified by an independent organization for compliance with AFNOR NF X 15-211 and AFNOR NF X 15-203 requirements.

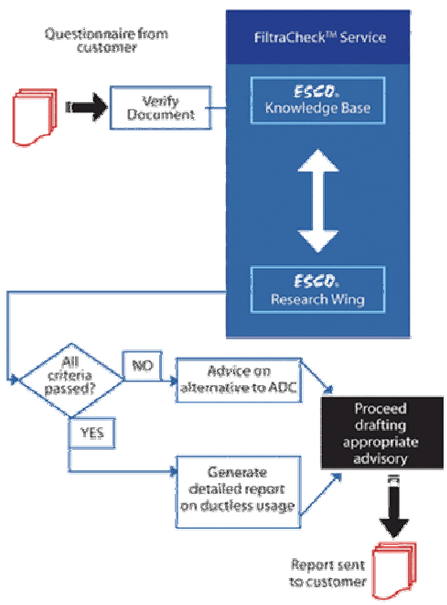
Please refer to chapter 2 of Section B (SERVICE SECTION) for detailed product specification.

1.11 FILTRACHECK™ CHEMICAL ADVISORY SERVICE

FiltraCheck is a trademark service provided by Esco's fume filtration division. Customers who intend to purchase a ductless fume hood but are unsure whether the cabinet is suitable for their application, can forward a list of chemicals that they will be handling and their pattern of usage to Esco's FiltraCheck service team.

A PDF Questionnaire form is available at http://ductless.escoglobal.com/. This questionnaire can be downloaded and either forwarded by email or by fax to Esco. After careful analysis of the provided chemicals list and pattern of usage, a proper advice document will be generated and provided to the customer in 3 days period.

This document will recommend the appropriate laboratory equipment; ducted fume hood or ductless fume hood or neither based on the investigation done by the FiltraCheck team. Depending on the type of chemicals used, the document may also contain a list of procedures, warnings, etc that will help in ensuring a safer laboratory working environment. In the case of a recommendation of a ductless cabinet, appropriate grade and type of activated carbon also becomes a factor that has to be taken into consideration.



Esco's FiltraCheck Diagram

CHAPTER II

UNPACKING YOUR CABINET

This chapter aims to provide relevant information on how to handle the cabinet properly upon receipt. Failure to follow the following instructions may cause damage to the cabinet. We strongly advise you to read this chapter carefully before proceeding further. Relevant information on **Warranty Terms and Conditions can be found on page 8**.

2.1 STEP-BY-STEP PROCEDURE

1. Inspecting the corrugated cardboard box

   Upon receipt of your new cabinet, inspect the cardboard box. If there is any visible damage to the exterior of the box please refer to **freight claim information on page 7**.

2. Moving the cardboard box

   a. The corrugated cardboard box has been designed to protect your cabinet from external impact. However, excessive impact on the box may damage the cabinet too. Hence all care should be taken to protect the box from direct impact during the course of moving it.

   b. While lifting and moving the box, please ensure that the floor jack or mechanical lift truck has entered fully under the box so that the box can be lifted stably. Otherwise there would be a risk of the box falling off from the floor jack or mechanical lift truck during handling. Whenever needed, please use suitably long extension bars.

Fig. 2: Moving the Box

Fig. 3: Unwrapping the carton box.

3. Opening the box

   a. If the unit is bundled with a support stand, you would find it strapped on top of the main cabinet box, and onto the pallet.
   b. Unwrap the protective plastic wrapping which covers the main box and the support stand box(if present)
   c. If straps are present, cut them now.
   d. Remove the top cover of the box – no tools required.
   e. Remove the carton box sleeves (side walls) by cutting the ends of the sleeve.
   f. All the other retrofit kits are packed separately and placed on top of the cabinet. These items are listed on the packing checklist pasted on the crate. Please check the packing checklist carefully to make sure that you have received all the items. Remove them from the top of the cabinet before proceeding further

If you did not receive one or more retrofit kits listed on the packing checklist, or if any item is damaged, please contact your distributor or Esco Micro Ptd Ltd immediately. Please refer to section 2.2 for complete listings of items (excluding the retrofit kits) included with your cabinet.

4. Removing the packaging material

a) The cabinet is protected by styrofoam and has been shrink-wrapped. The cabinet is secured to the pallet by means of straps.
b) Remove the styrofoam and shrink wrap but leave the straps securing the cabinet to the pallet intact. Ideally, the cabinet should remain strapped to the pallet until it has been placed in its final position.
c) If you find any damage during this stage of unpacking please refer to **freight claim information on page 7.**

For the cabinet to deliver optimal performance, it is very important to place it at the most suitable location. There are a lot of factors that determine the location best suited for the cabinet. Please refer to the next chapter for guidelines.

5. Moving the cabinet

a. While the pallet – with the cabinet strapped to it - is being lifted, make sure that the floor jack or mechanical lift truck has entered fully under the pallet. This would aid stable handling of the cabinet, while reducing the risk of the cabinet falling off. Please use extension bars whenever necessary.

b. While the cabinet is being moved, there should be adequate gap between the ground and supports of the pallet. The pallet should not be dragged on the ground as it would damage the pallet and possibly the cabinet too.

6. Removing the strapping

a. Remove the strapping by cutting it very carefully so as not to scratch the surface of your new cabinet

Fig. 4 Removing the strapping

b. Do not discard the packaging material of your cabinet until you have fully installed and tested the unit along with all its components.

7. Lifting the cabinet

The middle portion of the cabinet cannot support the weight of the cabinet for extended periods. Hence, as far as possible, the cabinet should not be lifted manually. The cabinet should rather be lifted using a mechanical lift truck. If manual lifting of the cabinet is absolutely essential, at least 6 persons should be employed while doing so.
While lifting the cabinet, there should be enough distance between the forks of the mechanical lift truck and the centre of the cabinet.
Recommended distance: 50 cm for 3 ft and 90 cm for 4ft and above

8. Install the cabinet on the existing work surface or Esco support stand (retrofit kit).

The Esco support stand along with instructions on installing it can be found inside the cardboard box.
It is recommended that the installation of the support stand be carried out by qualified personnel (your distributor).
If the cabinet is not installed on Esco's optional support stand, Esco cannot guarantee cabinet's resistance against tipping and hence the user would be solely responsible for ensuring that the cabinet is securely fastened to third part stand or table.
While installing the cabinet onto an existing work surface, ensure that the structure can safely support the combined weight of the cabinet and any related equipment. Some modifications to the work surface may be necessary.
The work surface should be smooth, nonporous and resistant to those disinfectants and chemicals, to which the cabinet is regularly exposed.

Esco Micro is committed to protecting the environment. Please re-use the pallet as far as possible and /or dispose off the packaging material and box in an environmentally responsible manner. Please hammer any exposed nail/sharp projection on the box's surface prior to disposal.

2.2 PACKAGING CONTENTS

The following items are included along with your manual:
1) Test certificate
2) Test report
3) 1 bag containing spare fasteners
4) 1 M4 and 1 M8 spanner screwdriver for maintenance and service
5) 1 yellow screwdriver for adjusting the speed control

The following items are permanently attached to the cabinet in a Ziploc bag:
1) Test report
2) Electrical diagram

In case this manual and/or test report are lost or misplaced, you have little to worry about. Esco retains a copy of the same. At any time, you may obtain a replacement copy by contacting Esco Micro Pte Ltd and stating the cabinet model, serial number and a brief description of the information you are seeking.

CHAPTER III
INSTALLING YOUR CABINET

3.1 ATTACHING THE SUPPORT STAND ONTO THE CABINET

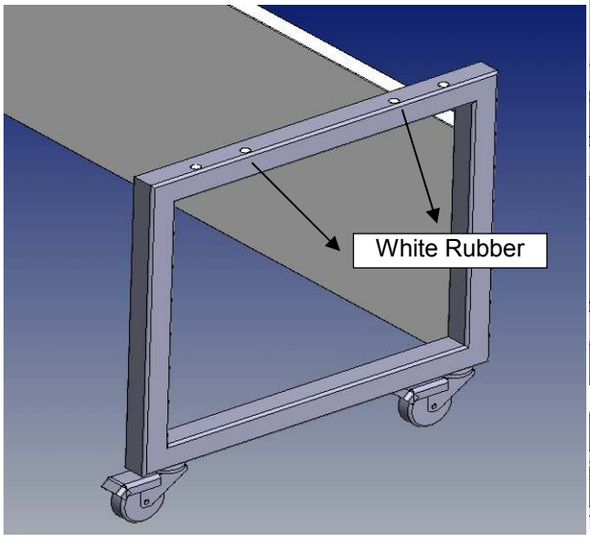


Figure A

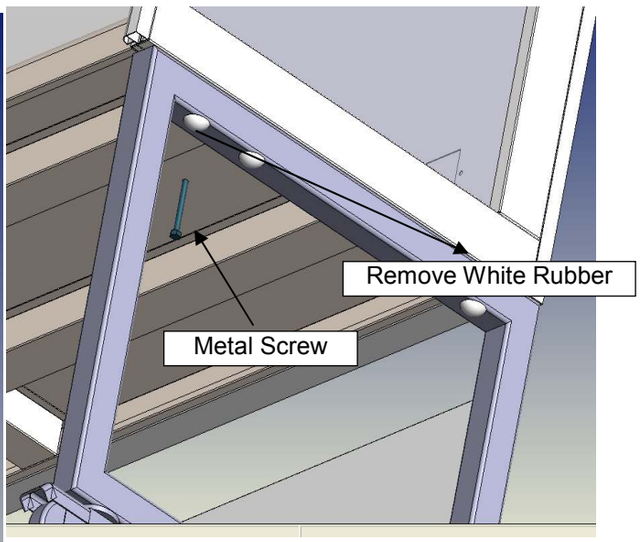


Figure B

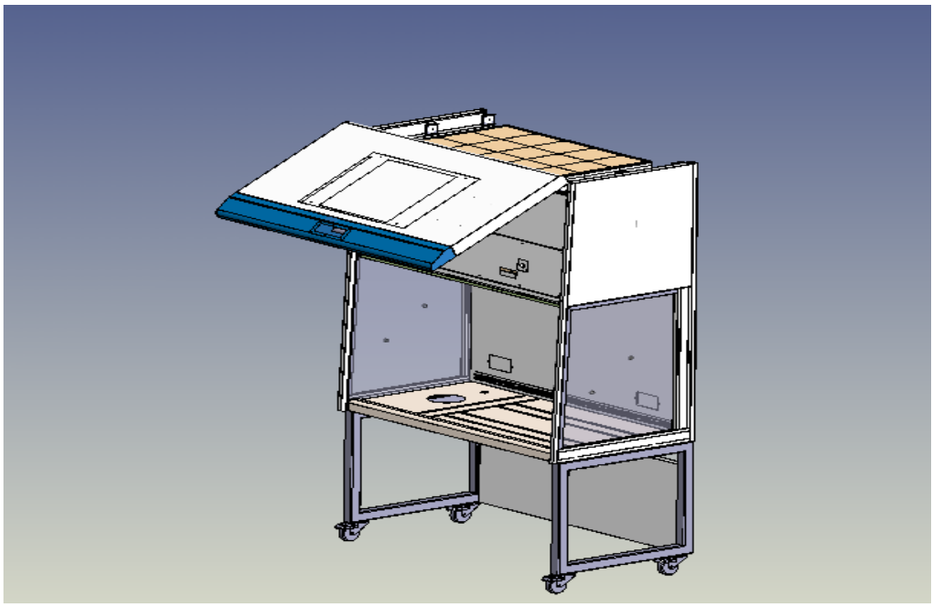


Figure C

Procedures:

- Remove all white rubbers from the support stand shown in figure A & B (do the same for the other side)
- Place the cabinet on top of the support stand and install the metal screws from underneath as shown in figure B (do the same for the other side)
- Installation is completed as shown in Figure C

3.2 INSTALLATION LOCATION REQUIREMENT

Installation location of the cabinet has a big impact on its overall performance. Installing the cabinet at a location where it is likely to be exposed to a lot of external airflow disturbances might lead to loss of containment. As can be seen in the graph below, your cabinet's internal airflow velocity is relatively small compared to the airflow disturbances potentially caused by opening of a door, a person walking by or for that matter being exposed to an air-conditioning outlet. All these things can therefore affect the proper functioning of a bio-safety cabinet, thereby impairing the protection offered by the cabinet to both the operator and the samples placed inside it.

Therefore while installing the cabinet, it should be located as far away as possible from the above-mentioned sources of airflow disturbance and in an orientation which optimally shields the cabinet's internal airflow from all external airflow disturbances. Besides, the cabinet should not be placed close to another cabinet.

Please refer to the extracts from *British Standard BS 7258- PART 2:1994* (printed with permission) in section 3.2 for more details on how to select a proper location for your cabinet. Other factors that need to be observed during installation include:

3.2.1 There should be adequate space left for cleaning the back of the cabinet and for carrying out decontamination procedure.

3.2.2 The location should be far away from any kind of heat source (heaters, fan converters etc.) for facilitating optimum operating conditions. Please refer to the environmental/electrical conditions on the next page for more detailed information

3.2.3 There should be unobstructed access to the main power supply point.

3.3 INSTALLATION LOCATION EXTRACTED FROM BS 7258

The following article is Esco's recommendation extracted from *British Standard BS 7258- PART 2:1994:*

To avoid disturbances to the fume cabinet and its operator, consideration should be given to the following:

a) The distance from the plane of the aperture to any circulation space should be at least 1000 mm, so as to preserve a zone undisturbed by anyone other than the operator – see figure 1a.

b) The distance between the front aperture and a bench opposite it should ideally be at least 1500 mm – see figure 1b. However, containment performance is not likely to be affected if this distance is reduced, for instance to enable an operator to use the bench behind whilst working at the cabinet. In this case operator movement over a smaller distance may cause less air disturbance. With such procedures their effect on containment should be measured by relevant operator protection factor tests.

c) There should be no opposing wall (or other obstruction likely to affect the airflow) within 2000 mm of the front aperture – see figure 1c.

d) Cabinets should not be installed in positions where they are likely to be affected by other items or equipment. In particular the distance to the aperture of an opposing cabinet, or the edge of a local exhaust ventilation outlet should be not less than 3000 mm – see figure 1d.

e) Any room air supply diffuser should not be within 1500 mm of the front aperture. If there are large numbers of safety cabinets in a laboratory this recommendation may be difficult to comply with, but where diffusers have to be placed in close proximity to a cabinet, their discharge velocities and therefore air handling rates will need to be low.

f) A cabinet should not be positioned with either side closer than 300 mm from a wall or similar obstruction – see figure 1e.

g) Large obstructions (e.g. and architectural column) projecting beyond the plane of the aperture should not be within 300 mm of the side of the fume cabinet – see figures 1f and g.

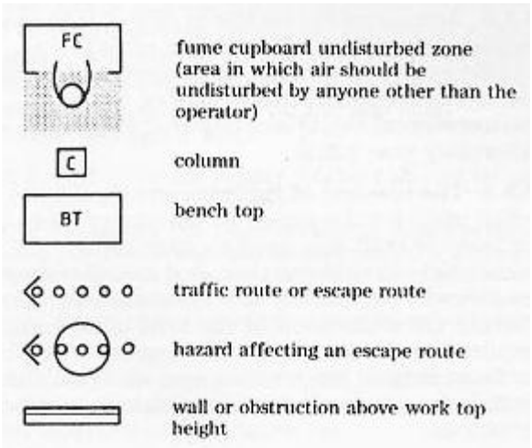
h) Doorways should not be within 1500 mm of the aperture or within 1000 mm of the side of the fume cabinet – see figure 1h – except where a door includes air transfer grills in which case protection factor testing should be carried out to ascertain a suitable distance.

The position of a cabinet should satisfy the spatial requirements (e.g. vision, lighting and convenience of access) of the operator and personnel working nearby. When a cabinet is installed on a bench top, the leading edge should be flush with or slightly overhanging the edge of the bench top.

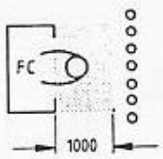
Note 1: Typical problems and their solutions are illustrated in figure 2.

Note 2: There should not be an open space between the leading edge of the cabinet and the front of the bench as this may create turbulence in front of the aperture. It also provides an obstacle which could adversely affect airflow across the cabinet face

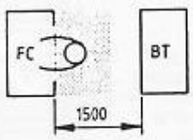
Key to figures 1 and 2


FC
fume cupboard undisturbed zone (area in which air should be undisturbed by anyone other than the operator)
C
column
BT
bench top
traffic route or escape route
hazard affecting an escape route
wall or obstruction above work top height

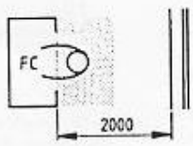
a) Separation of undisturbed zone from traffic routes



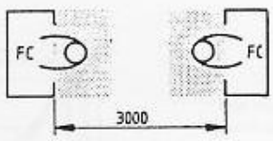
b) Spacing where same operator uses fume cupboard and bench top, or where occasional traffic only is anticipated



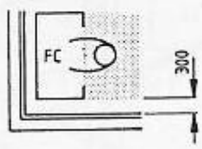
c) Spacing determined by air flow requirements



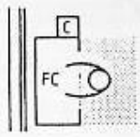
d) Spacing determined by air flow requirements



e) Spacing determined by air flow requirements

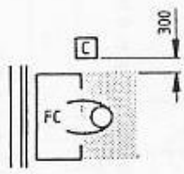


f) Spacings that avoid undue disturbance of air flow



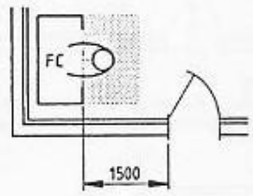
Face of column not in front of plane of sash

g) Spacings that avoid undue disturbance of air flow

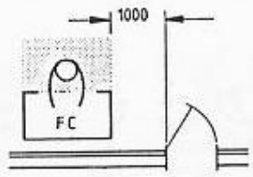


Face of column in front of plane of sash

h) Spacings that avoid undue disturbance of air flow (but see 3.1.2.8)



i) Spacings that avoid undue disturbance of air flow (but see 3.1.2.8)



All dimensions are in millimetres, and are minimum values.

Figure 1. Minimum distances for avoiding disturbance to the fume cupboard and its operator

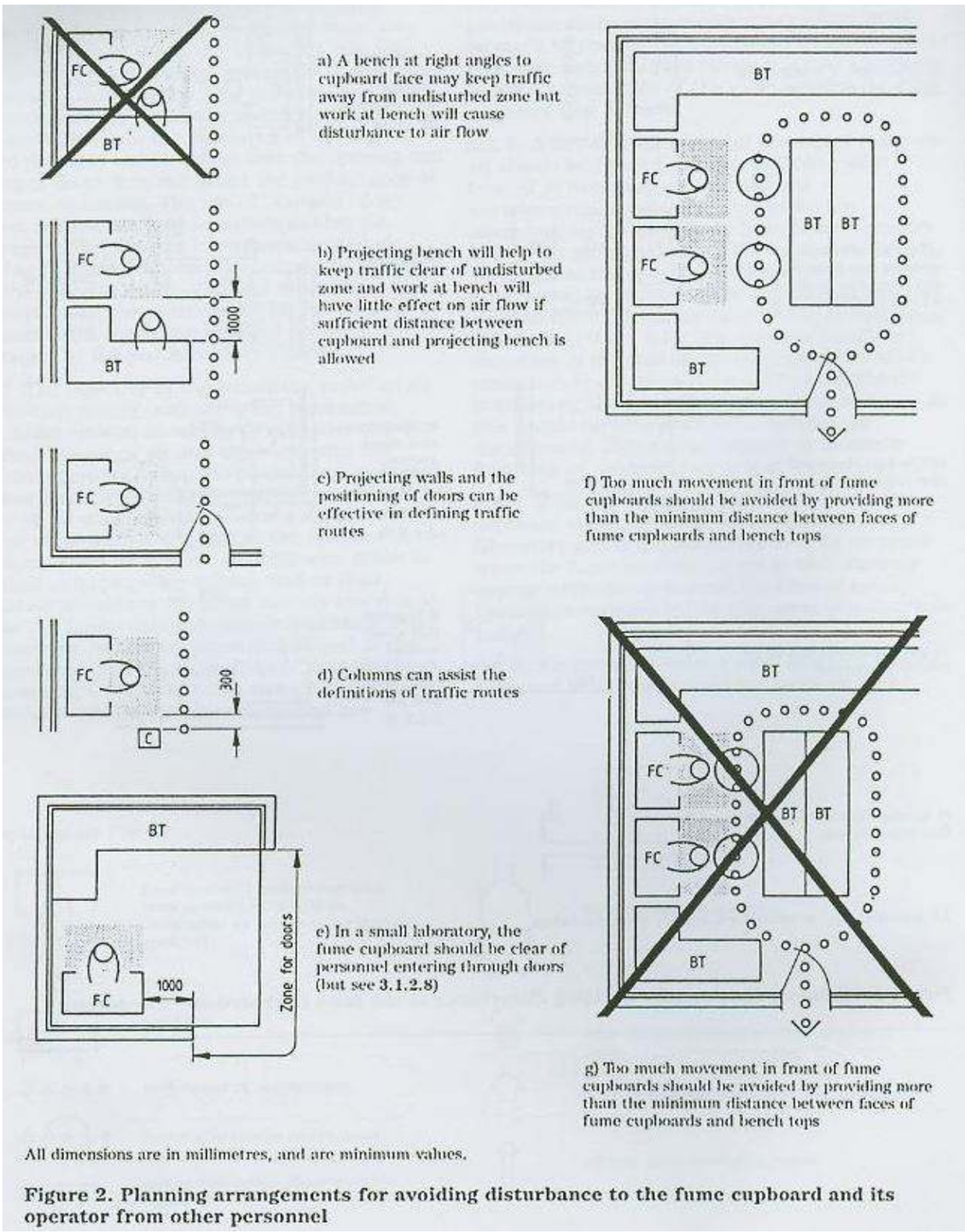

FC
BT
a) A bench at right angles to cupboard face may keep traffic away from undisturbed zone but work at bench will cause disturbance to air flow
1000
b) Projecting bench will help to keep traffic clear of undisturbed zone and work at bench will have little effect on air flow if sufficient distance between cupboard and projecting bench is allowed
c) Projecting walls and the positioning of doors can be effective in defining traffic routes
300
d) Columns can assist the definitions of traffic routes
Zone for doors
e) In a small laboratory, the fume cupboard should be clear of personnel entering through doors (but see 3.1.2.8)
f) Too much movement in front of fume cupboards should be avoided by providing more than the minimum distance between faces of fume cupboards and bench tops
g) Too much movement in front of fume cupboards should be avoided by providing more than the minimum distance between faces of fume cupboards and bench tops
All dimensions are in millimetres, and are minimum values.

Figure 2. Planning arrangements for avoiding disturbance to the fume cupboard and its operator from other personnel

3.4 CASE STUDY: CHOOSING THE BEST INSTALLATION LOCATION

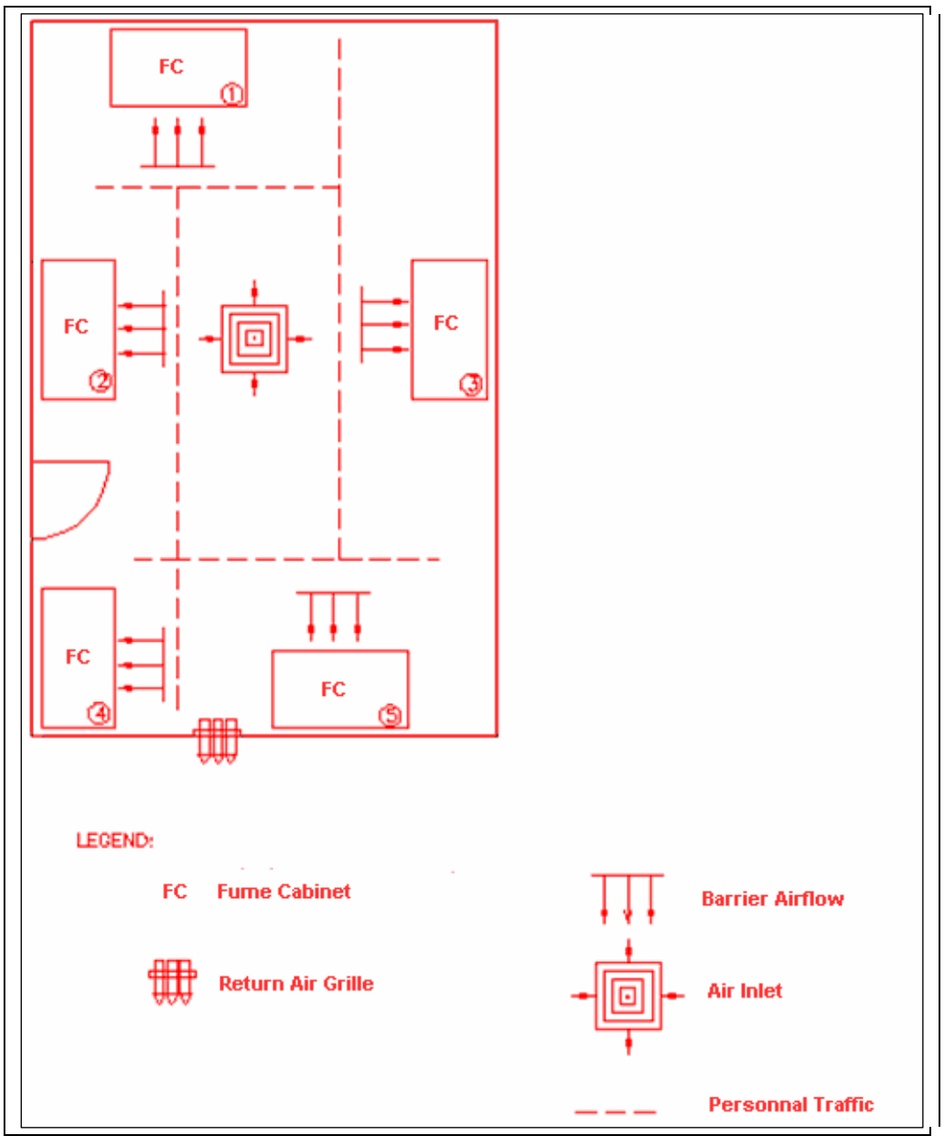


Fig. 5: Examples of the influence on cabinet airflow from room design and ventilation

1. Cabinet 1 is quite appropriately located with respect to avoidance of excessive air movements from surrounding areas
2. Cabinet 2 is too close to the doorway and its airflow could be influenced by the air inlet too
3. The airflow of cabinet 3 could also be influenced by the air inlet
4. Cabinet 4 is too close to the doorway.
5. Cabinet 5 is suitably located provided that the adjacent return air grille does not influence cabinet airflow.

Figure 5 illustrates various possible influences that can be induced by a room's design and ventilation system on the cabinet's airflow. Please note that Figure 5 does not depict any typical installation. In fact it is NOT recommended that so many cabinets be placed in a small room, or in close proximity to each other.

3.5 OPTIONAL RETROFIT KITS

1. Support Stand:

   To enable mobility of the cabinet within the laboratory and for users without bench space.
   Types available:
   a. Support stand with castor wheels
   b. Support stand with leveling feet
   c. Telescopic support stand (with adjustable height)
   d. Manual hydraulic support stand (with adjustable height)
   e. Motorized hydraulic support stand (with adjustable height)

Two persons would be needed for assembling the support stand as it is quite heavy
Should the cabinet be relocated after the initial installation, take all the necessary precautions as the cabinet is very heavy.
After relocation, the cabinet would have to be re-certified.

2. Service Fixtures (both European and American style fixtures available):

   To provide supply of gas, vacuum, water or compressed air to the cabinet. For vacuum fixture, please install a filter between the work zone and the fixture. Please refer to the diagram on page 24 for instructions on how to remove the side dress panel to install the service fixtures.

3. Electrical socket/GFCI outlets (total 5A rating for all outlets in cabinet):

   To allow users to use electrical devices, such as ultra-sonic bath, hotplate and electronic weighing scale inside the work-zone. For 115 V cabinets, the GFCI outlets will shut off in the event of earth leakage (4mA – 6mA).

4. Transparent back-wall for maximum visibility of the work zone from different angles:

   This feature is ideal for classrooms and educational demonstrations.

5. VOC sensor:

   To monitor ORGANIC chemical concentration within the cabinet work zone. The Sentinel® microprocessor control will activate audible / visual alarms for dangerously high concentration of chemical vapors

6. Secondary back-up filter:

   To offer higher filtration efficiency against toxic fumes and to comply with the requirements of ANSI/AIHA Z9.5-2003.

7. Motorized sash window:

   For automatic movement of the front sash glass controllable via the Sentinel® microprocessor control.

8. Air-tight exhaust collar:

   For exhausting trace amounts of volatile toxic chemicals outside the laboratory.

9. Base storage cabinet with castor wheels:

   To maximize storage space in the laboratory. Each cabinet includes an adjustable white powder-coated steel shelf.

3.6 INSTALLATIONS

1. Pay attention to **Section 2.1 (Step 7)** which contains guidelines on how to safely lift and move the cabinet.

2. Inspect your cabinet carefully. Should you find any defects, please refer to the **Freight Claim Information on page 7** and our **Warranty Terms and Conditions on page 8.**

3. Wipe the interior and exterior of the cabinet with water or a mild household detergent

4. Connect the cabinet to the main power supply. The fan is automatically switched on. PLS CHECK PANEL message is displayed; please check that all LEDs and buzzer are on for 6 seconds. Leave the blower on for 3 minutes (default warm-up time is 3 minutes; this setting can be changed though – refer to **section 4.2.1.2**).

5. **Each cabinet requires a dedicated 4A (230V) or 11.5A (115V) power socket which should not be shared with other appliances. For some cabinets which require 2 power sockets - one for the power outlets in the work zone (auxiliary power outlet) and the other for the cabinet blower and electrical systems - 2 separate and dedicated power outlets should be used.**

3.7 ENVIRONMENTAL/ELECTRICAL CONDITIONS

This cabinet has been designed to be used under the following conditions:

ENVIRONMENTAL

1. Indoor use
2. Altitudes of up to 2000 meters (6600 ft)
3. 20% - 60% relative humidity
4. Temperature should be in between 20 degree C and 30 degree C (68 deg F and 86 deg F).
   NB: It is recommended that the temperature in the laboratory be maintained within a +/-2 degree C range under all conditions
5. Pollution Degree * : 2.0

ELECTRICAL

6. Installation Category ** : II
7. It is also recommended that the voltage does not fluctuate by more than +/- 2% of the nominal voltage at any given time. Otherwise an electrical power stabilizer should be installed.
8. Electrical surge protector & back-up power supply (UPS) is strongly recommended for better protection. If UPS is not used and there is a power failure, the operator would have to take immediate measures to safeguard against any possible incidence of containment failure.
9. There should be unobstructed access to the main power plug on the power cord.
10. The leakage current for all electrical outlets put together should not exceed 2.0 mA.
11. At the time of carrying out the 'Voltage dips & short interruptions immunity' test, flickers were observed in the fluorescent light whenever the voltage dips and short interruptions were applied on the AC mains port of the cabinet. This condition got rectified automatically after the test. The cabinet is considered to meet performance criteria B in 'Voltage dips & short interruptions immunity test' based on the above observation.

** Pollution degree describes the amount of conductive pollutants present in an operating environment. In Pollution degree 2, it is assumed that only non-conductive pollutants such as dust are present, except that occasional conductivity is caused by condensation.*

*** Installation category (over voltage category) defines the level of transient over voltage that the instrument is designed to withstand safely. It depends on the nature of electricity supply and the cabinet's over voltage protection means. CAT II is a category used for instruments which can be plugged to a power point which is comparable to the public mains found in facilities such as hospitals, research laboratories and industrial laboratories. The expected transient over voltage in CAT II is 2500 V for a 230 V supply and 1500 V for a 120 V supply.*

3.8 PERFORMANCE VALIDATION/CERTIFICATION

After having installed the cabinet but before starting to use it, cabinet performance must be validated and certified to be meeting factory standards. It is recommended that this validation and certification be performed only by a **qualified technician** who is familiar with the methods and procedures for certifying cabinets. The testing methods and equipments needed for carrying out the tests are specified on the test report.

3.8.1 THE IMPORTANCE OF PERFOMANCE VALIDATION/CERTIFICATION

Studies have concluded that an estimated 50,000 to 70,000 workers around the world die each year from chronic occupational diseases resulting from past exposures to toxic substances. (Source: New York Committee for Occupational Safety and Health). Few of the salient points to take note of in this context are:

1. A significant proportion of end-users are largely ignorant, uninformed or simply just not serious enough about the availability of testing, safety specifications and implications of these specifications.
2. Velocity measurement or simple airflow visualization are insufficient for deciding the safety of cabinets.
3. Standardized testing procedures and certification help induce confidence in the tests, besides ensuring safety of the cabinets.

3.8.2 RE-CERTIFICATION

After the initial certification, the cabinet has to be re-certified (please refer to Service Section - Chapter 1, Sub-section 1 for more details) in the event of any of the following eventualities:

1. The cabinet has been relocated
2. The cause of airflow alarm could not be determined
3. There are doubts about the performance of the cabinet
4. Some major maintenance or servicing (filter changing, blower changing etc.) has been carried out

These eventualities apart, the cabinet must be re-certified at least once a year. In the case of cabinets that are used for more critical applications, re-certification should be done as frequently as every 6 months. **Airflow alarm should be re-calibrated strictly subject to the conditions specified in Service Section → Chapter 1 → Section 1.1 → Step 3(b).**

3.8.3 DISCLAIMER

The perfomance and safety of all Esco cabinets are rigorously evaluated at our factory. However we cannot guarantee similar levels of performance and safety after cabinet has been shipped and installed at the user's end because of possible wear and tear during transit. Hence we strongly recommend frequent on-site testing.

3.8.4 REFERENCES FOR QUALIFIED CERTIFIERS

1. Your nearest Esco distributor
2. Esco Micro Pte. Ltd.

CHAPTER IV
OPERATING YOUR CABINET

Good work practices are just as important as a good ductless fume cabinet itself in order to achieve effective containment of hazardous agents and samples. This chapter is aimed at providing the users with information on basic operations of this cabinet, besides outlining various recommended work practices, so that they are able to achieve optimal containment from their Esco ductless fume cabinets.

4.1 SENTINEL® CONTROL SYSTEM

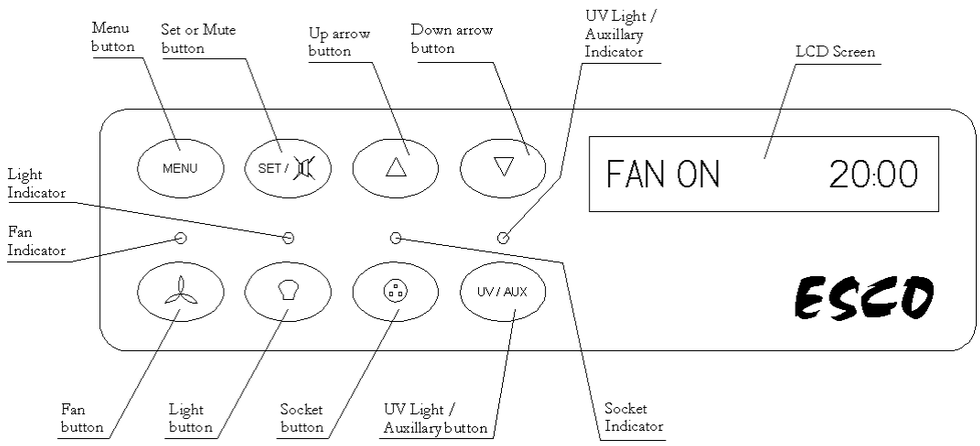


Fig. 6 Sentinel® Keypad User-interface

1. **Fan Button**
   To turn on and turn off the fan
   Refer to **section 4.2.3.2** for information on setting the **Fan PIN**

2. **Light Button**
   To turn on and turn off the light

3. **Socket Button**
   To turn on and turn off the electrical socket (retrofit kit)
   The maximum rating of all the outlets in the cabinet is 5 A. In case of overloading, the circuit breaker will trip. If that happens, disconnect the device from the outlet and reset the circuit breaker in the electrical control box (inside the front panel) by pressing its reset button. The leakage current for all electrical outlets combined should not exceed 2.8 mA.

Fig. 7A Screen confirms electrical outlet is on

Fig. 7B Screen confirms electrical outlet is off

4. **Up and Down Arrow Button**
   - To move up and down the menu options

- To increase and decrease the values of various parameters that can be adjusted under the various menu options
- To start, stop and reset timer
- To move the motorized sash (optional) up and down to adjust the height

Handheld stop watches should strictly be kept out of the work zone as they might be a source of contamination. For timing purposes, a TIMER function has been provided in the user interface and it functions as a stop watch (ONLY in READY state). Time is displayed in HH:MM:SS format. In timer mode, airflow is monitored.

User can start the timer by pressing the UP arrow button. Pressing UP button again stops the timer. Pressing the UP button yet again would resume the timer counting. Pressing DOWN button will take the user out of the timer mode, and “Timer Reset” message is displayed.

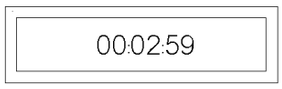


Fig. 9A Screen display when timer is running

Fig. 9B Screen display after timer is reset

Alternatively, the user may use the EXP TIMER function for countdown purposes. This timer has also been implemented for READY state only. Sash position and airflow velocity are monitored in this case too. User can start by pressing the DOWN button. If EXP TIMER is set to "00:00:00", "TIMER NOT SET!" message will be displayed (**Refer to Section 4.2.1.5** for guidelines on how to set the EXP Timer). Timer starts counting down otherwise. Pressing DOWN button again will stop the timer. User can then press DOWN button again to resume the timer. During this time, pressing UP button will take the user out of the timer mode, and “Timer Reset” message will be displayed. Once timer reaches "00:00:00", messages "TIMER COMPLETE.." and "PRESS UP KEY" will be displayed alternatively with an audible alarm.

5. **Set or Mute Button**
   - To select the menu or sub-menu option currently displayed on the LCD screen
   - To proceed to the next step under a given menu option
   - Sash alarm can be muted permanently by pressing SET button. Pressing SET button again will enable it. It’s protected by FAN PIN.

Alarm is disabled when you enter menu options

6. **Menu Button**
   - To enter / exit the menu options
   - To go back to the previous level of a given menu option
   - To access maintenance mode from AIRFAIL! And Temperature Alarm condition

Some of the menu options allow the user to customize the cabinet for a more personalized working experience. Refer to **section 4.2** for detailed explanation on the various menu options.

Before operating the cabinet, please ensure that you have **set the Admin PIN (0000 by default) and Fan PIN (0000 by default). Refer to section 4.2.3.1 and 4.2.3.2 for further instructions.**

The Admin PIN has higher priority and can be used to control the fan (override the Fan PIN) too. **Please contact Esco should you forget your ADMIN PIN.**

Concept of Different Sash Window States

1. The sash window should be at its normal operating height whenever the cabinet is being used. Except while loading/unloading apparatuses and items into/from the cabinet, the sash window should not be moved from its normal operating height, including when the cabinet is left unattended with the blower on.

2. The sash alarm will be activated whenever the sash window is moved from its normal operating height. Sash alarm can be muted permanently through configuration via the Sentinel control.

3. The sash window may be moved to MAXIMUM OPEN position for the purpose of loading/unloading apparatuses and items into/from the cabinet. Maximum opening the sash window would activate the sash alarm. It can however be muted. You may switch on the light to facilitate cleaning.

Motorised Sash Window Operation (Optional)

There are no additional switches added to the cabinet to control this feature. The sash window position can be adjusted using the UP or DOWN buttons of the SENTINEL® control system itself. While the sash window position is being adjusted, the control system gives out an audible alarm. This alarm can not be muted. At the time of adjusting the sash window position using the UP and DOWN buttons, the motor would automatically stop whenever the sash window reaches its normal operating height. A message reading “SASH MOVING…” is displayed whenever the UP or DOWN button is pressed to adjust the sash window position.

When the MENU options or Diagnostic messages are being accessed, the UP and DOWN buttons cannot be used to adjust the sash window position. During such times, the UP and DOWN buttons are usable only for scrolling up and down the menu options and for changing the various setting parameters. Besides that, for safety reasons, the motorized sash window cannot be operated when the warm up period or purging period is underway; or when the AIRFAIL errors occur.

Do not operate your motorized window continuously for more than 4 minutes because the thermal protector will overheat causing the power to the sash motor to be cut off.
Allow 5-6 minutes for the sash motor to cool down if the sash motor is overheated.
Typically, a longer usage will require a longer rest before operating the sash motor again.

4.1.1 SOFTWARE SELF-RESET

Sentinel® is equipped with watchdog timer. The timer runs in the background and detects any possible incidence of software malfunction. Once a malfunction occurs, the timer will reset the system. During system reset (which takes approximately 30 seconds), the cabinet will undergo warm-up cycle; blower would be on but light and electrical outlet would be off. After reset, the system will resume normal operation. Note that no data is erased or reset to the default values.

4.1.2 HARDWARE RESET

Sentinel® can also be reset by pressing RESET button available on the main board; refer to **Product Specification on chapter 2 of SERVICE SECTION** for exact position.

This hardware-reset function can be used in case of controller malfunction, e.g. blank LCD for more than 5 seconds. After RESET button is pressed, the system will restart. Note that no data is erased or reset to default values after hardware reset.

Do not press the RESET button during normal usage as it will disrupt the operation of the cabinet, thereby compromising safety of the operator.

4.2 MENU OPTIONS

When you are entering menu options, the alarm will sound to indicate that the microprocessor is not monitoring the operation of the cabinet and as such will not give airflow alarms. No further warnings will be given. Therefore, it is highly recommended that the user set the ADMIN PIN, which will restrict unauthorized access to the menu. Please refer to section 4.2.3.1 for further details. The default ADMIN PIN from the factory is 0000.

The diagram below illustrates the complete heirarchy of menu options available in this cabinet. Press UP or DOWN button to move through the various menu options. Users are strongly advised to exit the menu options after the requisite adjustment(s) have been made so that any unathorized access to the menu options thereafter can be prevented.

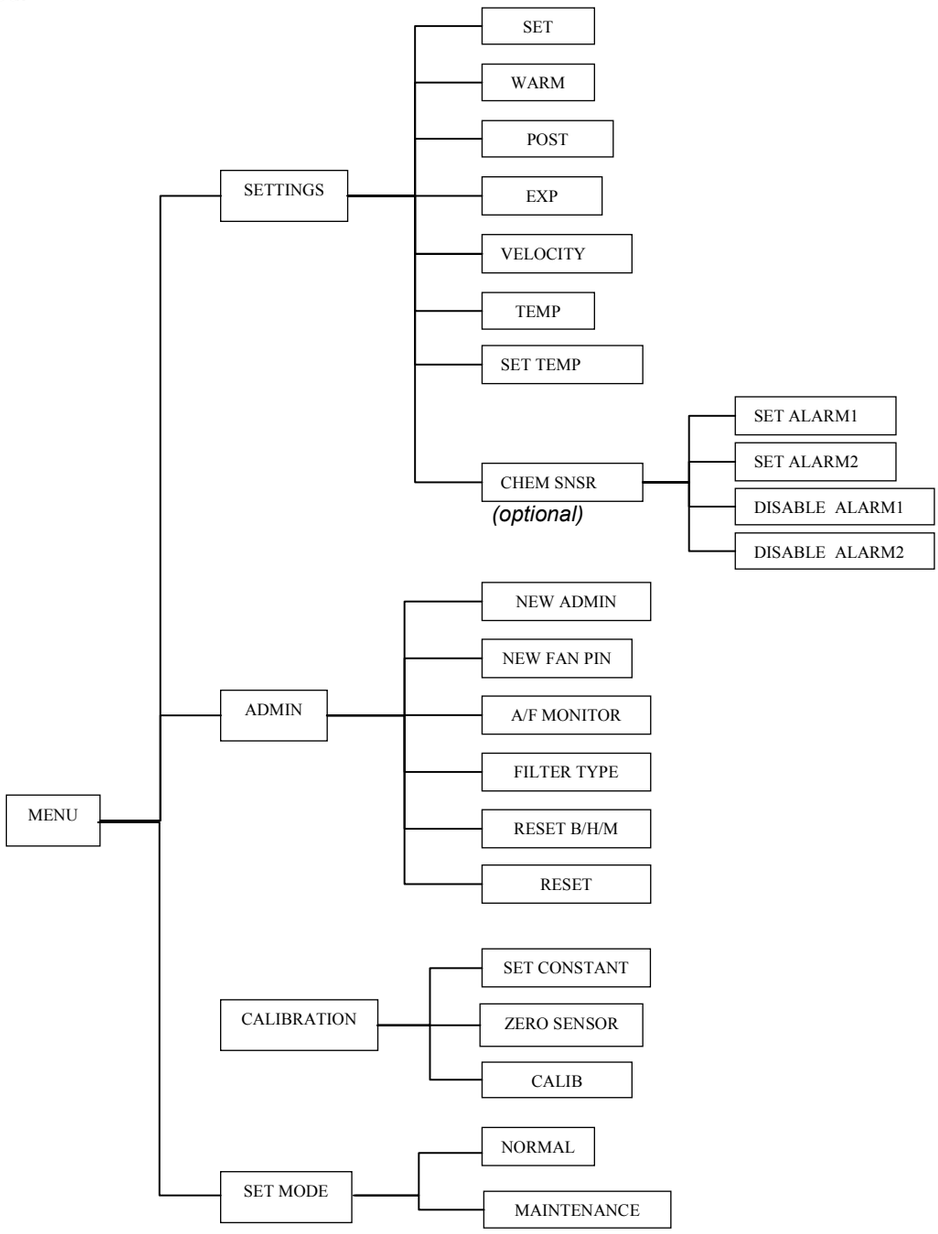


Fig. 10 Hierarchy of menu-options

4.2.1 SETTINGS (CLOCK, TIMER, AND UNITS)

Press SET to enter the SETTINGS menu. Use the UP and DOWN button to move through the available options. Press MENU to go back to the previous level.

4.2.1.1 SET CLOCK (TIME)

Users can set the time by increasing/decreasing the hour and minute values. The time setting is NOT lost even when the cabinet has been switched off.

Press SET button to enter the SET TIME menu. The hour display will blink.
Press UP or DOWN arrow button to choose the correct hour value.
Press SET. The minute display will then start blinking.
Press UP or DOWN arrow button to choose the correct minute value.
Press SET button to confirm the changes.

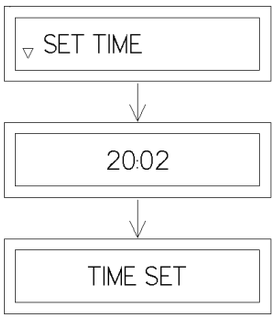


Fig. 11 Display sequence to set time

4.2.1.2 WARM UP TIMER

Before the fan becomes fully functional, there is a time lag for the purpose of 'warm-up'. This is to allow some time to the sensors, fan, and the control system to stabilize. During this time contaminants in the work zone are purged as well. The default warm-up time is 3 minutes but the users can set it to any duration up to 15 minutes.

Press SET button to enter the WARM UP menu. The minute display will blink.
Press UP or DOWN arrow button to choose the correct minute value.
Press SET button to confirm the changes.

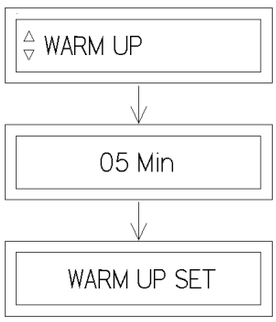


Fig. 12 Display sequence to set warm up time

4.2.1.3 POST PURGE TIMER

After the user switches off the fan, there will be a period of 'post-purge'. During this time all residual contaminants in the work zone are purged. The default 'post-purge' time is 0 minutes but the users can set it to any duration from 0 to 15 minutes. Setting it to 0 minute would effectively amount to disabling this feature. However it is recommended that the post-purge timing be set to at least 3 minutes.

Press SET button to enter the POST PURGE menu. The minute display will blink.
Press UP or DOWN arrow button to choose the correct minute value.
Press SET button to confirm the changes.

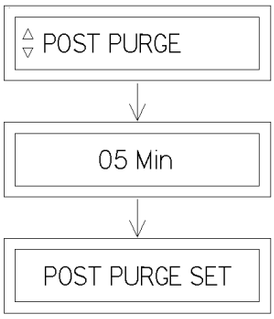


Fig. 13 Display sequence to set post purge time

4.2.1.4 EXP TIMER

To monitor the timing for critical experiments, EXP TIMER menu can be used. It basically serves as a countdown timer. You can set the EXP TIMER to any time period between “00:00:00” and “17:59:59” (HH:MM:SS format).
Press SET button to enter the EXP TIMER menu. The hour display will blink.
Press UP or DOWN arrow button to choose the correct hour value.
Press SET. The minute value will blink.
Press UP or DOWN arrow button to choose the correct minute value.
Press SET. The second display will blink.
Press SET button to confirm the change

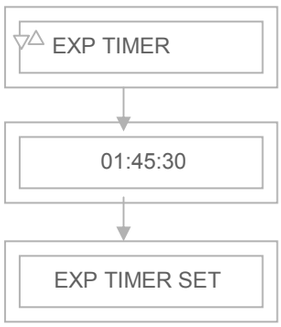


Fig. 14 Display sequence to set EXP timer

4.2.1.5 AIR VELOCITY UNIT SELECTION

Using this option, you can select the unit in which airflow is measured and displayed. You can choose between meter per second (m/s) and feet per minute (fpm). When the fan is running and also during the calibration process, airflow measurement is displayed in the selected unit.

Press SET button to enter the VELOCITY UNIT menu.
Press UP or DOWN arrow button to select the desired measurement unit.
Press SET button to confirm the changes.

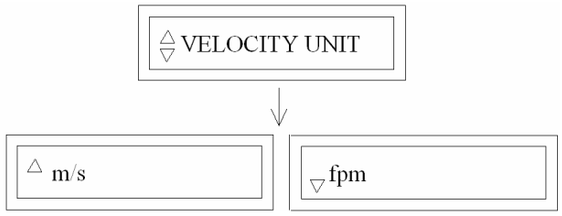


Fig. 15 Display sequence to select Velocity unit

4.2.1.6 TEMPERATURE UNIT SELECTION

Using this option, you can select the unit in which temperature is measured and displayed. You can choose between Celsius and Fahrenheit. The exhaust temperature is displayed in the selected unit.

Press SET button to enter the TEMP UNIT menu.
Press UP or DOWN arrow button to select the desired measurement unit.
Press SET button to confirm the changes.

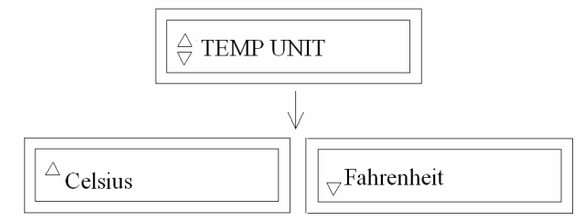


Fig. 16 Display sequence to select temperature unit

4.2.1.7 SET TEMPERATURE ALARM

This option allows the setting of high / low temperature alarm to signal operator when a chemical experiment causes the temperature inside the workzone to exceed above or to fall below a certain level that can be hazarduous to the experiment and/or operator. The temperature sensor is located on top of the work zone, below the filter. You may select a suitable high / low temperature limit for your application between 30 to 99 degree Celcius or 86-210 degree Fahrenheit. The default setting is set to 99 degree Celcius.

Temperature alarm has higher priority than airflow alarm, but lower priority than sash alarm

4.2.1.8 CHEMICAL SENSOR ALARMS *(Only for ADC with VOC sensor)*

This option allows the setting of high Chemical Sensor output voltage alarm to signal operator when a chemical experiment causes the chemical concentration inside the workzone to exceed above a certain level that can be hazarduous to the operator. The chemical sensor is located on top of the work zone, after the filter. You may select a suitable high voltage limit for your application between 0 to 5000mV for each of the alarms.

The first alarm purpose is to warn the operator that the filter is about to reach saturation (A suitable value can be of 0.50 to 1.00V lesser than the second alarm).
The second alarm purpose is to alert the operator to stop the experiment immediately.
The appropriate warning messages will appear on screen when the alarm will sound.
The default settings are that the first alarm is disabled and second alarm is set at 3750mV.

The Chemical Sensor Alarms Sub-menu allows setting the alarms threshold voltage, or disabling the alarms.

4.2.1.8.1 SETTING AN ALARM

Setting a voltage for alarm activation can be done in the following manner:

- Select the requested alarm from the sub-menu
- The current voltage value will be displayed on the screen.
  For example:

```
Alarm 2: 3.75V
```

- The leftmost digit of the voltage value will blink. Use the UP/DOWN keys to adjust it, and the SET key to continue to the next digit, or MENU to cancel.

4.2.1.8.2 DISABLING AN ALARM

To disable an alarm , select the disable alarm option from the Chemical Sensor Alarms Sub-menu, according to the alarm requires disabling.

The chemical sensor alarm is prioritised as the 4th alarm.

4.2.2 CALIBRATION

Press SET to enter the CALIBRATION menu. Use the UP and DOWN button to move through the available options. Press MENU to go back to the previous level.

4.2.2.1 SET CONSTANT

Every sensor manufactured by Esco has a specific Sensor Constant which is used for temperature compensation performed by the temperature sensor. For more information on this option, please refer to Microprocessor Calibration section of the Test Report.

4.2.2.2 ZERO SENSOR

This option is to let the controller record a specific sensor output voltage and correspond it to 0cmh or 0cfm. Please refer to Microprocessor Calibration section of the Test Report for details on how to use this option.

4.2.2.3 CALIB SENSOR

This option allows proper calibration and operation of the airflow sensor alarm. There are two points that have to be calibrated, namely airflow minimum point 0.30m/s (LOW inflow alarm) and airflow maximum point 0.50m/s (HIGH inflow alarm). More details on this option can be found in Microprocessor Calibration section of the Test Report.

Calibration must be performed by qualified personnel.
Airflow alarm should be re-calibrated strictly subject to the conditions specified in Service Section → Chapter 1 → Section 1.1 → Step 3(b).

4.2.3 ADMINISTRATOR ACCESS AND PIN

Press SET to enter the ADMIN menu. Use the UP and DOWN button to move through the available options. Press MENU to go back to the previous level

4.2.3.1 NEW ADMIN PIN

ADMIN PIN restricts access to MENU functions, including service functions like calibration. After the Admin PIN has been set, one will have to correctly key in the four-digit PIN before being granted access to the MENU. Admin PIN has higher priority and can also be used to control the fan (override Fan PIN).

ADMIN PIN can also be used to switch to Maintenance Mode from AIRFAIL! error conditions. The default PIN is 0000. Setting PIN to 0000 will disable this feature. Please follow the following steps to set a new ADMIN PIN.

Press SET button to enter the NEW ADMIN PIN menu. The first-digit display will blink.
Press UP or DOWN arrow button to choose the desired first-digit of the ADMIN PIN.
Press SET. The second-digit will start blinking.

Press UP or DOWN arrow button to choose the desired second-digit of the ADMIN PIN.
Repeat steps until the fourth-digit of the ADMIN PIN has been chosen.
Press SET button to confirm the changes.

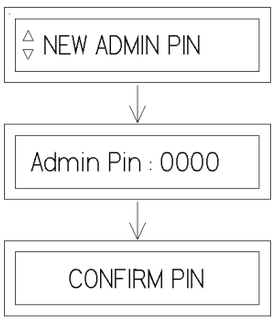


Fig.17 Display sequence to set admin PIN

4.2.3.2 NEW FAN PIN

FAN PIN restricts access to the fan controls. Once the FAN PIN has been set, one will have to correctly key in the four-digit PIN before being allowed to switch the fan on or off. As such, the FAN PIN can be an effective guard against unauthorized personnel operating the cabinet. FAN PIN can also effectively prevent unauthorized shutdown of the cabinet when in fact it needs to be in operation continuously for a prolonged period of time. Please note that continuous operation is recommended for enhanced safety.
It is recommended that the FAN PIN be issued only to personnel authorized to use the cabinet. The default PIN is 0000. Setting the PIN to 0000 will disable this feature. Please follow the following steps to set a new FAN PIN.

Press SET button to enter the NEW FAN PIN menu. The first-digit display will blink.
Press UP or DOWN arrow button to choose the desired first digit of the NEW FAN PIN.
Press SET. The second-digit will start blinking.
Press UP or DOWN arrow button to choose the desired second digit of the NEW FAN PIN.
Repeat steps until the fourth-digit of the NEW FAN PIN has been chosen.
Press SET button to confirm the changes.

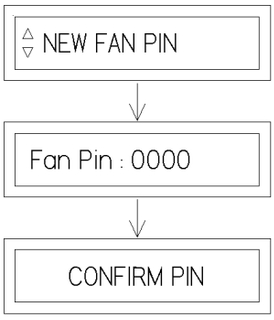


Fig.18 Display sequence to set fan PIN

4.2.3.3 A/F MONITOR

Whenever the airflow falls below the fail point, the air fail alarm is triggered. This option can be used to enable/disable the alarm. By default, this feature is enabled

Press SET button to enter the A/F MONITOR menu.

Press UP or DOWN arrow button to enable or disable the A/F MONITOR.
Press SET button to confirm the changes.

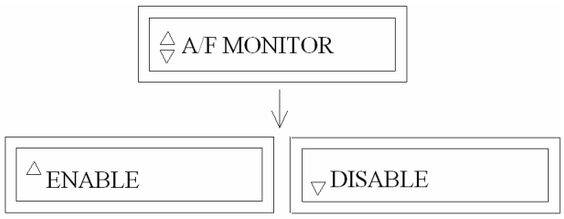


Fig. 19 Display sequence to set alarm setting feature

Disabling the air fail alarm is not recommended during normal operation. However this may be necessary during the installation of exhaust collar or ducting system.

4.2.3.4 FILTER TYPE

This option is to select the different filter type (Standard, Acid, Mercury, Sulphur, Halogen, Aldehyde, Ammonia).
Press SET button to enter the FILTER TYPE menu.
Press UP or DOWN arrow button to choose the filter type value.

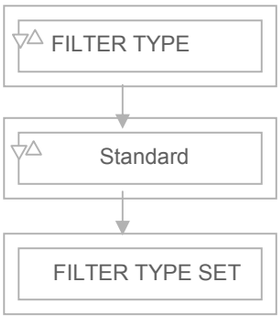


Fig. 20 Display sequence to set FILTER TYPE

4.2.3.5 RESET BLOWER HOUR METER

This option is used to reset the blower hour meter. The blower hour meter keeps a count of how long the blower has been in operation. It can count up to a maximum of 9999 hours. The counter value can be checked while in maintenance mode. You can even draw up the maintenance schedule – including when to change filter - based on the reading of blower hour meter. Please refer to the SERVICE SECTION for more details.

4.2.3.6 RESET DEFAULT

You can reset the default settings/values for few of the parameters discussed above by choosing this option. The features that can be reset are WARM-UP period (factory default setting: 3 minutes), POST-PURGE period (factory default setting: 0 minute), UV TIMER (factory default setting: 0 min), EXP TIMER (factory default setting: 00:00:00), VELOCITY UNIT (factory default setting: m/s), TEMP UNIT (factory default setting: Celsius), and FAN PIN (factory default setting: 0000). Note that the calibration settings cannot be reset as it may cause the cabinet to operate in an unsafe manner. The hour meters cannot be reset either.

Press SET button to enter the RESET DEFAULT menu
Press SET button to confirm the reset

4.2.4 SETTING THE MODE

Press SET to enter the SET MODE menu. Use the UP and DOWN button to move through the available options. Press MENU to go back to the previous level.

4.2.4.1 NORMAL MODE

This is the default operation mode. When the cabinet is restarted, it goes into this mode by default.

4.2.4.2 MAINTENANCE MODE

This mode should only be used during maintenance by qualified personnel.

The maintenance mode can be used for the following purposes:

1. Calibration/ Performance validation
2. Checking of input/output diagnostics

Please refer to Microprocessor Calibration section of the Test Report for more details.

4.3 STARTING THE CABINET

1. Prepare a written checklist of materials/apparatus necessary for immediate usage.

2. Turn on the blower and raise the sash (default FAN PIN is 0000). Leave the blower on for 3 minutes (default warm-up time is 3 minutes; this setting can be changed though - refer to **section 4.2.1.2**). If the cabinet is just being plugged to the electrical power source, PLS CHECK PANEL message would be displayed; please check that all LEDs and buzzer are on for 6 seconds.

3. Adjust the seating position for optimal operator comfort. It is recommended to use a height adjustable stool. **Refer to section 4.4 on ergonomics** for more information.

4. After all the apparatuses/items have been arranged, adjust the sash to its normal operating height and allow the blower to run for another 3 minutes in order to purge work zone of contaminants.

5. Minimize room activity (personnel movements, closing and opening of doors, etc.) since these external airflow disturbances may adversely affect the cabinet's internal airflow, thereby possibly impairing the containment capabilities of the cabinet.

Users are strongly discouraged from using gas Bunsen burners in the cabinet. These burners give rise to thermal currents which in turn causes disturbance in the internal airflow of the cabinet. This could compromise the overall performance of the cabinet.

Should the use of Bunsen burner be unavoidable, use only the burners recommended below:

1. Manufacturer: Integra Bioscience
   Product: Fireboy plus
   Web page: http://www.integra-biosciences.com/fireboy_plus_1_e.html

Comments:

The advantage of this burner is that the flame is automatically cut off by either a time delay or when the footswitch is not activated. This ensures that the duration for which the burner operates at the full flame setting required for sterilization is minimal. Therefore its effect on the cabinet's airflow is minimized. In addition it is very safe and reliable (compared to ordinary Bunsen burners) due to features like excess-temperature protection, flame monitor and alarm display.

2. Manufacturer: Waterpik
   Product: TOUCH-O-MATIC® Bunsen Burner
   Web page:
http://professional.waterpik.com/ViewCoreProductNow.cfm?ProductID=76&Appl=4

Comments:

The advantage of this burner is that the flame is automatically reduced when the operator removes his/her hand from the platform. The flame's original intensity is restored as soon as the operator places his/her hand back on the platform (during this time, the flame's intensity is still enough for sterilization). Therefore, compared to a constant setting burner which always operates at a high setting for sterilization, the effect on cabinet airflow is minimized to a large extent in this case.

4.4 WORKING IN THE CABINET

4.4.1 WORKING ERGONOMICS

On most occasions, you would most likely be operating the cabinet in sitting posture. There are some obvious advantages of the sitting posture:

1. The physiological energy cost and fatigue involved in sitting are relatively less
2. Sitting posture provides the body with a stable support

However, sitting position has some drawbacks too:

1. The working area available is fairly limited
2. There is a potential risk of being constrained in the same posture for a long time
3. Sitting posture is one of the most stressful postures for one's back

Therefore you should pay careful attention to the following guidelines in order to achieve comfortable and healthy working conditions:

1. Always ensure that your legs have enough legroom.
2. Keep the lower back comfortably supported by your chair. Adjust the chair or use a pillow behind your back whenever necessary.
3. You should place your feet flat on the floor or on a footrest. Don't dangle your feet and compress your thighs
4. You should keep varying your sitting position throughout the day at regular intervals so that you are never in the same posture for too long.
5. Observe the following precautions with respect to your eyes:
   a. Give your eyes frequent breaks. Periodically look away from the work area and focus at a distant point.
   b. Keep your glasses clean.
6. Arrange the items/apparatuses frequently used in your work in such a way that you can minimize the physical strain involved in handling them.
7. Exercise regularly

Ergonomics accessories available with Esco include:

- **a. Armrest padding**
- **b. Lab chair**
- **c. Footrest**

Please contact your local distributor or Esco for more information.

4.5 CLEANING AND SHUTTING DOWN THE CABINET

1. **As far as possible, it is recommended that the cabinet be operated continuously in order to achieve optimal containment and cleanliness**.

   NB: Airflow studies have shown that once the fan has been switched off, air from the cabinet may escape due to the thermal currents from inside the cabinet. So if you choose to turn off the cabinet, you need to carefully adhere to the following guidelines so as NOT to compromise safety and containment during shutdown.

2. Thoroughly wipe the work surface, side walls, inner back wall and drain pan using water and some mild detergent. Periodically clean behind the sash window too.

3. Wipe off the detergent using water. Make sure that there are no traces of detergent left.

4. Leave the blower on for 3 minutes in order to purge the work zone. (default post-purge cycle time is 0 minute; this setting can be changed though - refer to **section 4.2.1.3**)

CHAPTER V

MAINTAINING YOUR CABINET

5.1 MAINTENANCE SCHEDULE

COSHH regulations from the UK Health & Safety Executive (HSE) require that equipment to control exposure is properly maintained. It must be thoroughly examined and tested every fourteen (14) months and records kept of this. This 14-monthly period specified suggests annual maintenance with two months grace which is equivalent to Esco annual maintenance schedule.

In view of this, proper and timely maintenance is crucial for trouble free functioning of any device and your Esco cabinet is no exception to this rule. We strongly recommend that you follow the maintenance schedule suggested hereunder in order to obtain optimal performance from your Esco cabinet.

Maintenance work to be carried out weekly

1. Check the alarm and measure the basic airflow (Please refer to the test report for details).
2. Clean the interior work surface and walls with soap water
3. Wipe down sash with appropriate glass cleaner.

Maintenance work to be carried out monthly

1. Inspect the controls of the services to the fume hood for proper operation.
2. Clean the exterior surface of the fume hood with damp cloth.
3. Determine the face velocity across the fully open sash position and ensure that fume hood is operating at specified face velocity (please refer to Appendix B).

Maintenance work to be carried out quarterly

1. Inspect the fans, motors, drives and bearings for correct operation
2. Check fluorescent tubes and to ensure that they are functioning normally.
3. Check filter saturation (please refer to Appendix A).
4. Measure the fume hood face velocity (please refer to Appendix B). Correct as necessary.
5. Test the operation of the airflow alarm
6. Repair defects and lubricate as necessary.
7. For removing stubborn stains / spots on the stainless steel surface, make use of MEK (Methyl-Ethyl-Ketone). In such cases, make sure that you wash the steel surface immediately afterwards with clean water and some liquid detergent. Use polyurethane cloth or sponge for washing. Regularly cleaning the stainless steel surface would help you retain the attractive factory finish.

Maintenance work to be carried out annually

1. ***Have the cabinet recertified by a qualified certification technician.***
   For more information, refer to Chapter III section 3.4 on performance validation/certification
2. Quarterly maintenance prescribed above.

Maintenance work to be carried out biannually

1. Replace the fluorescent lamps
2. Annual maintenance prescribed above.

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SERVICE SECTION

CHAPTER I

RE-CERTIFICATION AND MAINTENANCE BY SERVICE PERSONNEL

1.1 AIRFLOW VERIFICATION & CABINET RE-CERTIFICATION

Re-certification must be performed during any of the following eventualities:

1. New installation
2. Relocation of cabinet
3. The cause of activation of airflow alarm cannot be determined
4. Whenever cabinet performance is suspected
5. At least once in a year

Please refer to the test report for detailed description of method and equipments required for performing the certification testing. The original test report has been packed along with this manual. A copy of the test report is inside the plastic bag pasted adjacent to the electrical control panel.

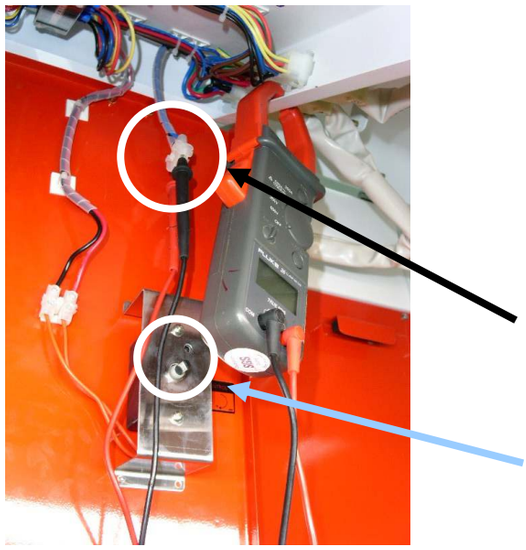
Steps to perform certification:

1. Turn on the cabinet for **≥10 minutes** to allow the speed control to reach 99% of the target voltage output.

2. Check the nominal inflow and downflow values in the test report. Check if the corresponding values displayed on the LCD are within +/- 0.02 m/s of the values in the test report. If yes then you may proceed to Step 3, or else proceed to step 2a:

    a. Open the electrical control panel.

b. Plug the voltmeter probes to the Motor Voltage Sampling Port, as indicated by the white circle in the pictures below.



For both 115V / 230V models

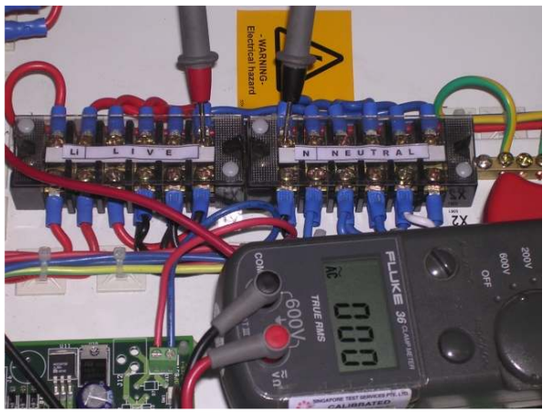
Plug the voltmeter to the blue and red (old model is blue and black) wires joined by a white open-end connector.

Adjust the speed control by turning the knob of the speed controller

VOLTAGE SAMPLING PORT

SPEED
CONTROLLER KNOB

c. If the motor voltage differs from the Nominal Motor Voltage mentioned in the Test Conditions Documentation Sheet of the Test Report, the speed control would need to be adjusted so that the motor voltage matches the Nominal Motor Voltage in the Test Report. Your building supply voltage may differ from the supply voltage at the Esco Test Lab. This supply voltage difference will roughly double the blower voltage difference, creating a more significant airflow discrepancy. To measure the building supply voltage:



Building supply voltage of 230 V cabinet

Plug one voltmeter probe to the LIVE terminal block (red wires), and the other probe to the NEUTRAL terminal block (blue wires)

For example:

	Esco factory	Your laboratory
Building supply voltage	230 V	220 V
Motor (blower) voltage	135 V	118 V

In this case, the motor voltage must be increased from 118 volt to 135 volt by turning the speed control clockwise in order to match the given motor voltage at the Esco factory. Please note that the difference between the motor voltages is always greater than the difference between the building supply voltages. Therefore, in this case, it is not enough to increase the motor voltage just by 10 volts

(which is the difference between the building supply voltages). Rather it needs to be increased by 17 volts.

3. Using thermo-anemometer, check the inflow velocity of the cabinet to make sure that:

   a. The inflow velocities vary from the nominal point given in the test report by no more than 0.025 m/s. If the deviation is more than 0.025 m/s, adjust the speed control to get the nominal inflow setpoint. If either of nominal inflow cannot be achieved by speed control adjustment, then the cabinet would need re-balancing.

   b. The inflow velocities are within 0.02 m/s from the velocity values displayed on the LCD. **If and only if the velocity values displayed on LCD vary by more than 0.02 m/s from the actual inflow velocity, the microprocessor would need to be re-calibrated.** Please refer to the Microprocessor Calibration section of the Test Report.

4. Perform the filter retention efficiency (filter saturation test). Please refer to Appendix A.

5. Perform site installation assessment test

6. You are recommended to perform the following optional tests too:

   a. Operator comfort tests: light, noise, and vibration

   b. Electrical safety test

Esco conducts training courses on the validation and certification of fume cabinets. If you are interested you are most welcome to contact Esco Micro Pte Ltd or your nearest Esco distributor.

1.2 CALIBRATION OF SENTINEL™ CONTROL

The purpose of calibrating the controller is to let the controller record particular output voltages from the airflow sensor and correspond them to minimum and maximum points of air velocity. Once the calibration has been completed, the control will be able to show the air velocity whenever the fan is in operation. All Esco cabinets are factory-tested and calibrated before being shipped.

Calibration is required in the following eventualities:

- The cause of airflow alarm cannot be determined
- At the time of annual re-certification

Please refer to the calibration section of the test report for the details on steps involved in calibration, equipments needed for carrying out calibration and other testing procedures. The calibration must be done in the maintenance mode.

1.2.1 Sentinel control display in maintenance mode

DISPLAY	DESCRIPTION
C201 V2.2 C201A V1.1 C201 V3.0 C201A V2.0	Software version (Standard ADC) Software version (ADC with motorized window) Software version (ADC with VOC sensor) Software version (ADC with motorized window and VOC sensor)
M.: Maintenance	Mode
M.SWITCH: ON/OFF	Magnetic switch mode
FAN: ON/OFF	Fan status
WARM UP: XX	Warm up time
PURGE:XX	Purging time
B/H/M:XXXX	Blower hour meter
F/C/D: XX-XX-XX	Year (04-32), Month (0-12), Day (0-31)

LIGHT: ON/OFF	Light status
SOCKET: ON/OFF	Socket status
A/F MONITOR:D/E	Airflow monitor status (enable or disable)
ADC A/F : XXXX	ADC value of current air-velocity sensor
ADC ZERO: XXXX	ADC value of airflow zero point
ADC MIN: XXXX	ADC value of airflow fail point
ADC MAX: XXXX	ADC value of airflow optimal point
ADC TEMP: XXXX	ADC value of temperature sensor
TEMP : 00 °C/F	Current temperature (Celsius or Fahrenheit)
CONSTANT: 050	Temperature compensation formula constant
CHM SNSR: XXXX	Output voltage of the Chemical Sensor

ADC stands for Analog to Digital Conversion

1.3 SOFTWARE UPDATING

Esco sometimes releases upgraded versions of the Sentinel® control's embedded software. The upgraded version can be downloaded from our website using a toolkit that can be purchased from Esco at a nominal cost

You do not have to compulsorily upgrade your Sentinel® control's embedded software unless it is for safety considerations. You can download the software upgrades from http://biotech.escoglobal.com/support/sentinel

WARNING: SOFTWARE UPDATE PROCEDURE WILL CAUSE CALIBRATION DATA TO BE ERASED FROM YOUR SYSTEM. ENSURE THAT THE SYSTEM IS RECALIBRATED AFTERWARDS

1.4 SASH POSITION DETECTION

Esco cabinets use magnetic-switch in order to help the control system keep track of the position of the sash window.

Magnetic-Switch	***Description***
Open	Sash window is not in normal operating height; SASH ALARM is sounded
Close	Sash window is at normal operating height; Cabinet is ready for use

If the displayed message does not match the actual sash position, check the state of the magnetic switch by removing the sash profile.

1.5 REPLACEMENT OF FILTER

Under normal usage and barring any accident (example - puncture), the filter do not need replacement unless and until the inflow velocity cannot be maintained at the specifications required by the testing report even though the fan has been set to maximum speed.

1. Ensure that the motor is shut off first.
2. Remove the filter panel cover at the front by unscrewing it (Note that you may have to remove the sash).
3. Pull the handle that holds the filter in place. The plate will be lifted up to release the filters.
4. Pull the filter banks using the handle provided.
5. Replace the used filter with a new one
6. Repeat the procedure in reverse order to complete the replacement.

1.6 REPLACEMENT OF FLUORESCENT LAMP

1. Check the replacement parts list at the end of this manual.
2. Disconnect the electrical connections.
3. Unfasten the two screws from the bottom of the blue panel and then lift up the blue panel.
   Caution: The front panel is equipped with a gas spring which will open the front panel automatically.
4. The fluorescent lamp(s) are located behind the blue panel. Remove the old one(s) from their socket(s) and replace back with the new one(s).

CHAPTER II

SELF-CHECK TEST TO DETERMINE ACTIVATED CARBON SATURATION POINT

Color indicator tubes can be used as a quick pass/ fail method to check for air purity, in other words, also for determining when it is time to change Activated Carbon filters whereby the concentration of chemical used after adsorption is above its threshold values. There are several indicator tubes' manufacturers, namely, Draeger and Gastec tubes which appear to be the most widely used. Tubes made by different manufacturers may not be interchangeable because of size, volume and flow rate requirements.

Apparatus required:

- Portable Hand Pump (or electric pump or flowing gas system)
- Appropriate Color Indicator Tubes *(contact your Esco distributor for selecting appropriate detection tubes)*
- Suitable Connectors (tubings)

Description:

Color indicator tubes are sealed glass tubes which contains chemicals that react with a specific compound (such as toluene, ethanol, moisture, carbon monoxide, and so on) to form a color or stain in it. The concentration of the contaminant (specific chemical compound) is determined by the length of the stain or from color intensity after passing a known required volume of air through it.

- Procedures of Testing Compressed Air with Detection Tubes (Color Indicator Tubes):

1) Break both ends (tips) of the glass tube with the tube opener
2) Insert the tube tightly into the pump with arrow points towards the pump
3) Connect a suitable tubing to the exhaust (any point after the filter) of ductless cabinet
4) To the other end of the tubing, fix it to the other opening of the glass tube
5) Using pump to suck the air through the tube by discrete-stroke (non-continuous) where the correct volume is determined by the number of strokes
6) Read the entire length of the discoloration immediately which corresponds to the concentration of contaminant (specific chemical compound) in the air sampled

Advantages:

1. Once you own the hardware, you can perform the tests on compressor air as well as air in storage banks
2. You can perform the tests any time you wish
3. You do not have to contact a laboratory
4. The results are instantaneous
5. It is relatively cheap as an analysis measurement
6. Color indicator tubes satisfy OSHA compressed air testing requirements in the US
7. Color Tubes provide good indications of a problem telling end users that it is time to change filters

CHAPTER III
PRODUCT SPECIFICATION

CONTENTS:

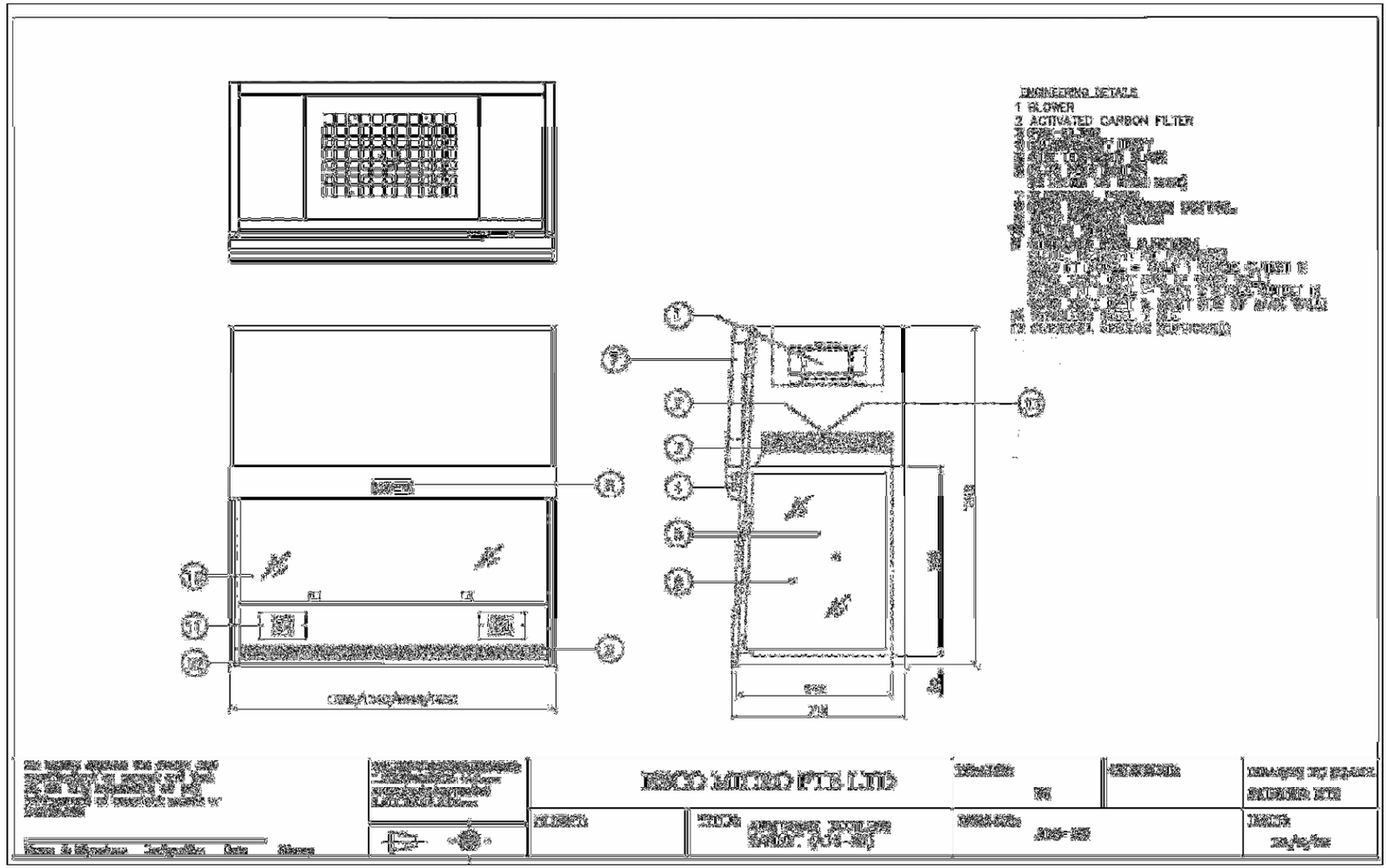
Engineering Diagram of All Models of Different Sizes

Technical Specification Summary Table

Electrical Schematics of Each Power Rating Variant

Microprocessor Specification

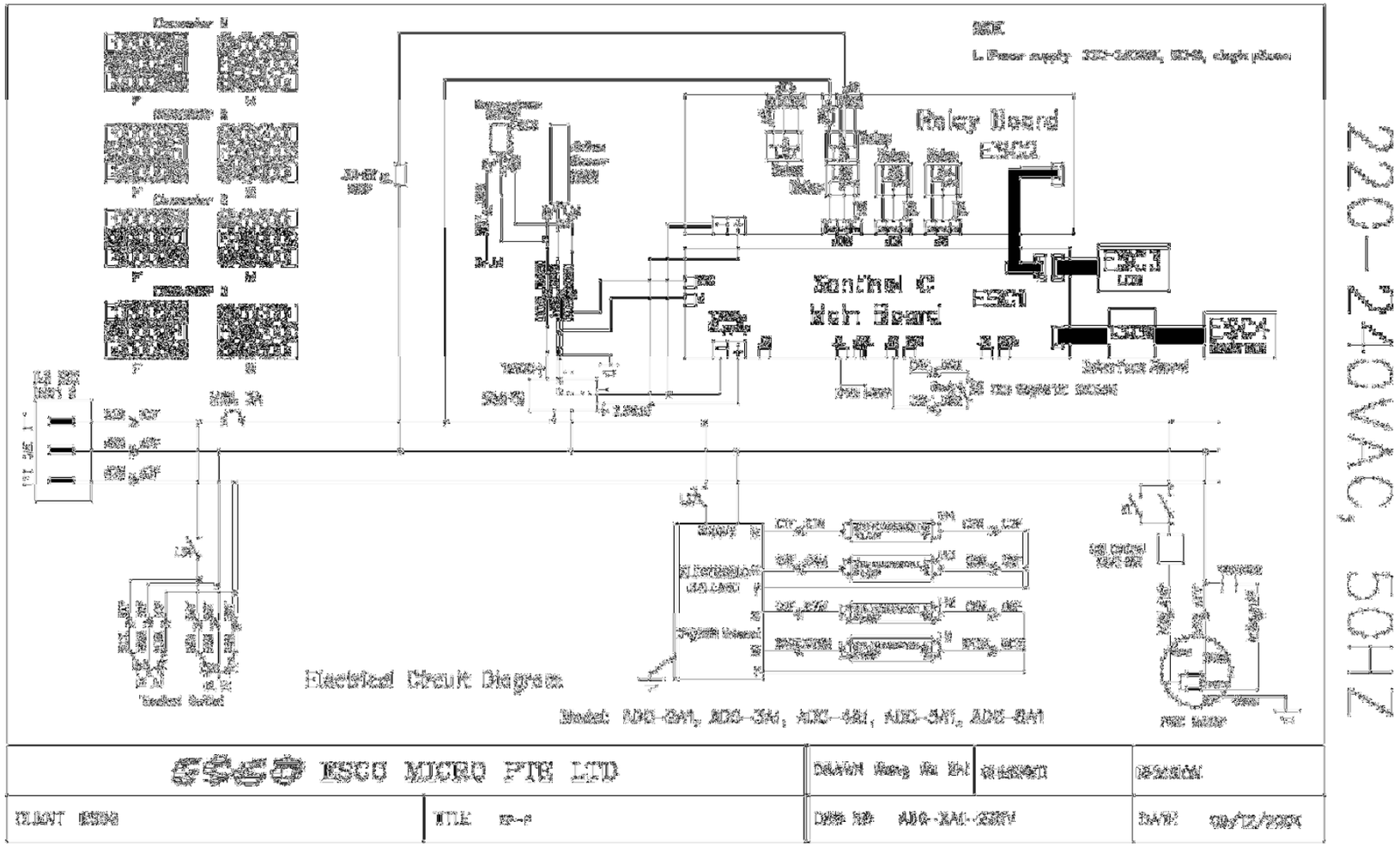
3.1 Engineering Details



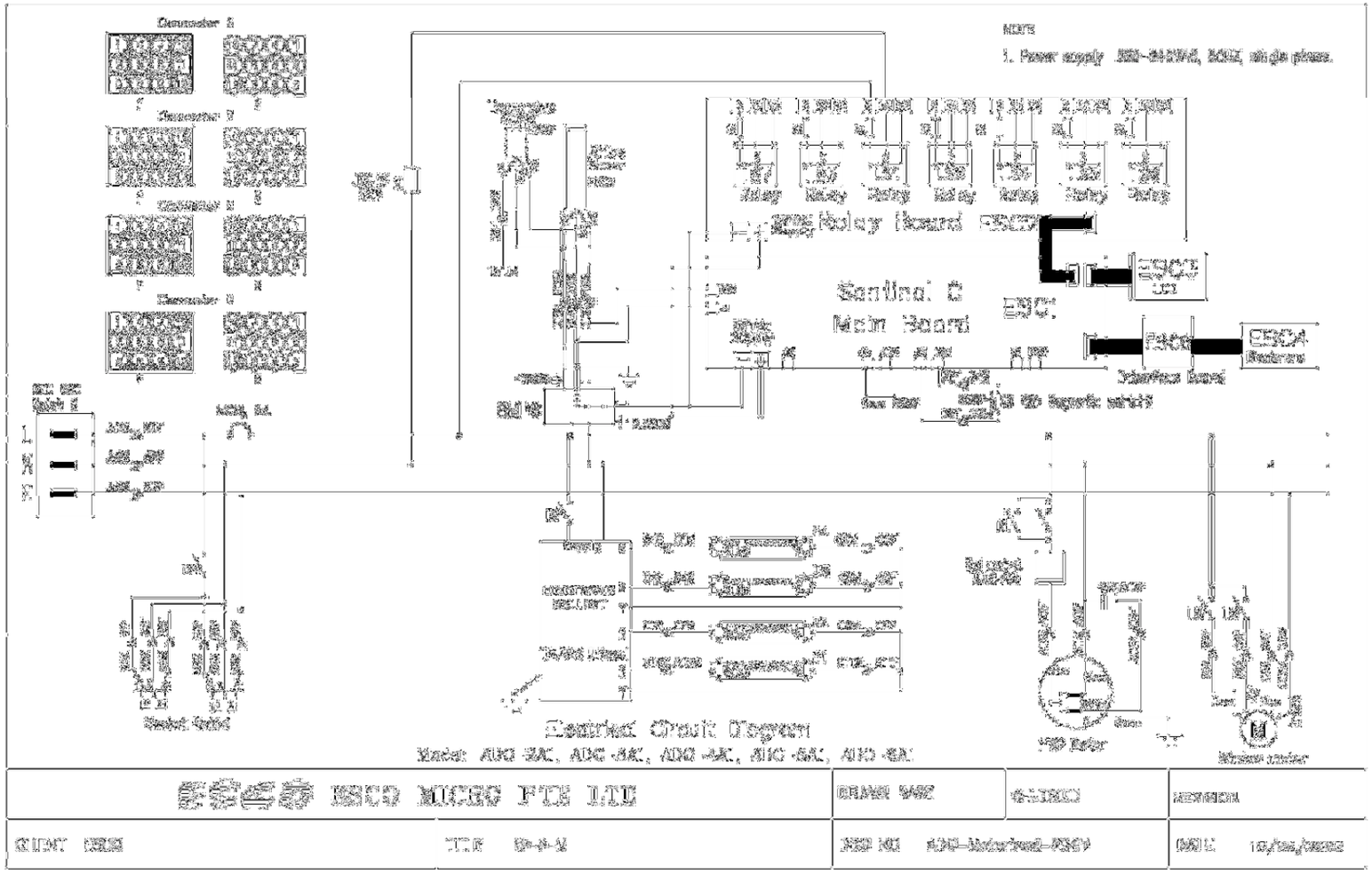
3.2 Technical Specifications

General Specifications	ADC-3BX	ADC-4BX	ADC-5BX	ADC-6BX
External Dimensions (L x W x H)	1035 X 713 X 1410 mm 40.7" x 28.1" x 55.5"	1340 x 713 x 1410 mm 52.8" x 28.1" x 55.5"	1645 x 713 x 1410 mm 64.8" x 28.1" x 55.5"	1950 x 713 x 1410 mm 76.8" x 28.1" x 55.5"
Internal Work zone (L x W x H)	965 x 642 x 780 mm 40.7" x 25.3" x 30.7"	1268 x 642 x 780 mm 50.0" x 25.3" x 30.7"	1575 x 642 x 780 mm 64.8" x 25.3" x 30.7"	1880 x 642 x 780 mm 76.8" x 25.3" x 30.7"
Standards Compliance	Designed and manufactured to meet and exceed the requirements of: ASHRAE 110, AS2243.9 - 1991, BS 7989 - 2001, AFNOR NF X 15-211 and ANSI/AIHA Z9.7-1998. Electrical safety: IEC 61010-1 / EN 61010-1 / UL 61010A-1 / CSA C22.2 No. 1010.1-92			
Standard Filtration Elements	Main filter: Activated carbon with granular media bed (7 different filter types available - refer to page 5 of this catalogue. State required filter type when ordering). Pre-filter: Washable non-woven polyester fibres with an efficiency of 20% against gross particulate matter			
Total Carbon Filter Weight	20 kgs (2 filters x 10 kgs each)	26 kgs (2 filters x 13 kgs each)	33 kgs (3 filters x 11 kgs each)	42 kgs (3 filters x 14 kgs each)
Inflow Air Velocity	Initial setpoint: 0.50 m/s or 100 fpm			
Inflow	353 cmh / 208 cfm	463 cmh / 273 cfm	575 cmh / 339 cfm	687 cmh / 404 cfm
Light Intensity	>1000 Lux / >93 footcandles *The above measurements were taken at work surface level (zero background)*			
Main Body Construction	1.2mmt - 1.5mmt / 0.05" - 0.06" / 16 gauge electro-galvanised steel with white oven-baked epoxy powder-coated finish			
Power Supply Options	Choose from the following options and specify number when ordering (e.g. ADC-4B**2** for a 110-130VAC 60HZ configuration) **1.** 220-240VAC 50HZ, 1 phase **2**. 110-130VAC 60HZ, 1 phase **3**. 220-240VAC 60HZ, 1 phase **4.** 110-130VAC 50HZ, 1 phase **5**. 100-110VAC 50HZ / 60HZ			
Max Shipping Dimensions (L x W x H)	1135 x 813 x 1510 mm 44.7" x 32.0" x 59.4"	1440 x 813 x 1510 mm 56.7" x 32.0" x 59.4"	1745 x 813 x 1510 mm 68.7" x 32.0" x 59.4"	2050 x 813 x 1510 mm 80.7" x 32.0" x 59.4"
Max Shipping Volume	1.39 cbm / 49.1 cbf	1.77 cbm / 62.5 cbf	2.14 cbm / 75.6 cbf	2.52 cbm / 89 cbf

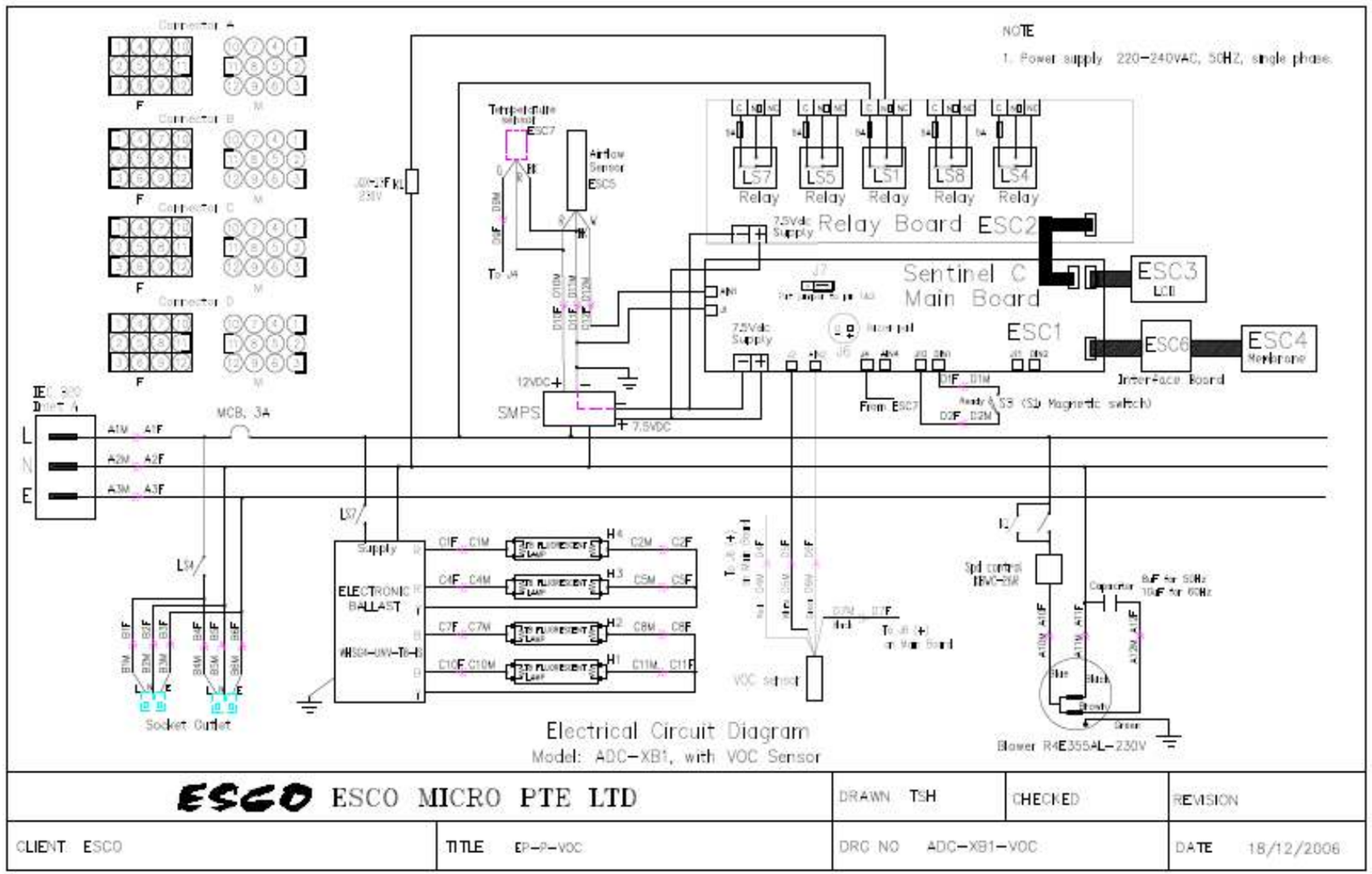
3.3 Electrical Schematic for Standard ADC (230V)



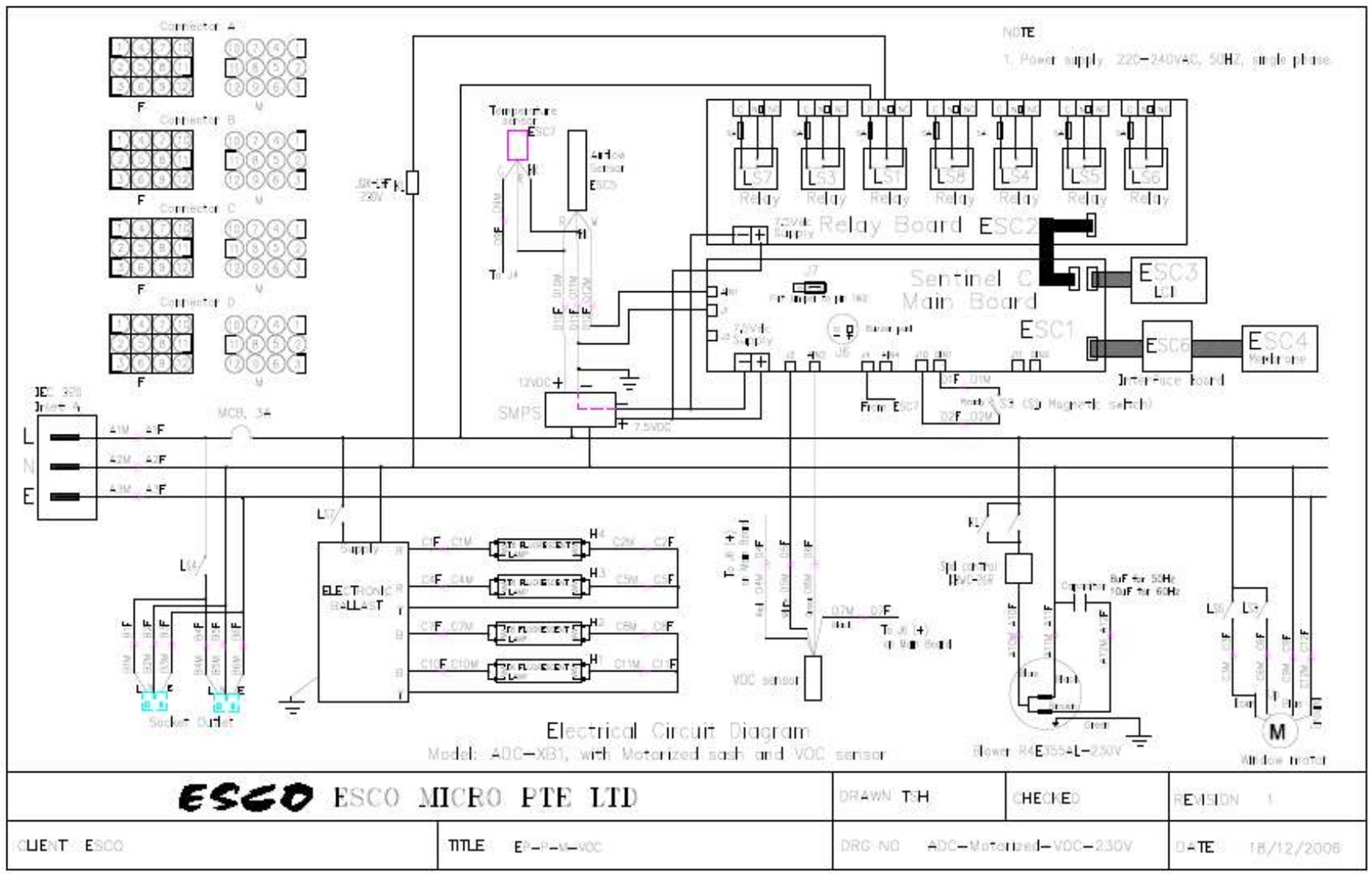
3.4 Electrical Schematic for ADC with Motorized Sash Window (230V)



3.5 Electrical Schematic for ADC with VOC sensor (230V)



3.6 Electrical Schematic of ADC with VOC sensor and Motorized Sash Window (230V)

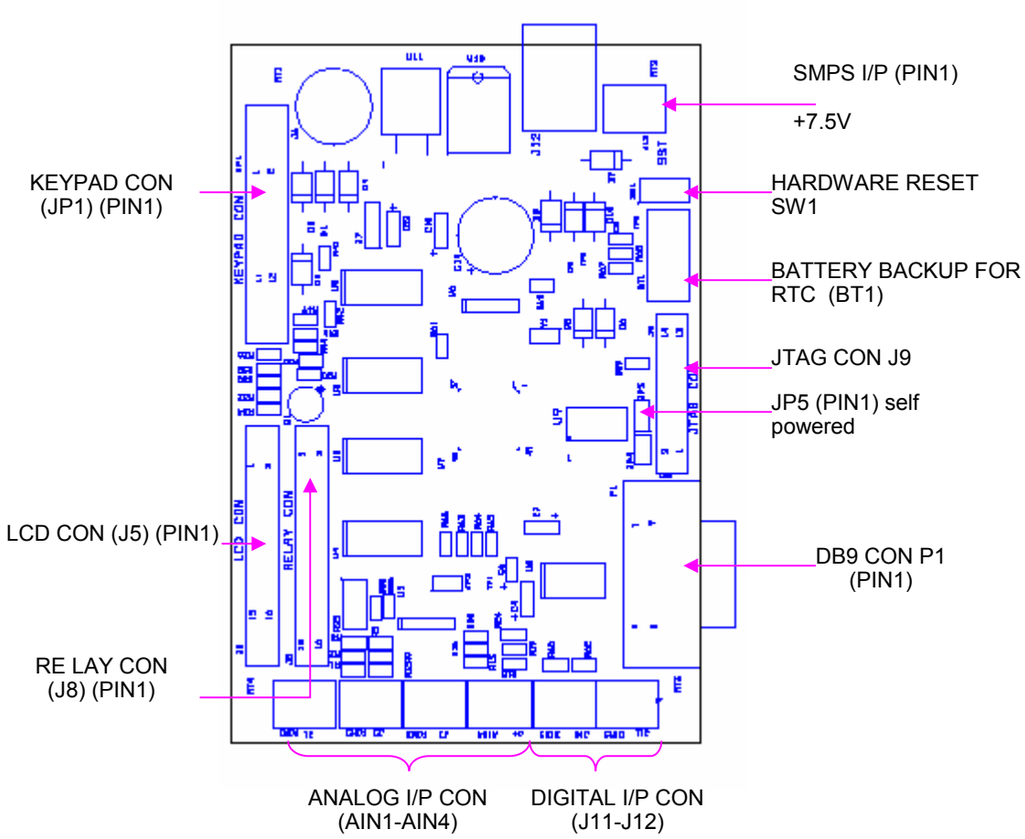


3.7 SENTINEL CONTROL SYSTEM

Mains Input Voltage: 100-240VAC
Mains Input Frequency: 50/60Hz
Sentinel® Control Input Voltage: 7.5VDC
Max input current: 500mA
Electromagnetic interference

Hardware requirement:

- PSC, backward curve fan
- Fluorescent light and ballast
- Sentinel® Control, comprising of main board, relay board, interface board, and 1x16 LCD screen
- Airflow sensor, Input 12VDC
- Temperature Sensor, Input 12VDC
- Keypad and dual output SMPS



Picture 16: Top view of Sentinel® main board with components

CHAPTER IV
TROUBLESHOOTING

This section helps you troubleshoot some of the common problems you might face while operating this cabinet. Should you have any queries left unanswered here, please feel free to contact Esco.

4.1 ELECTRICAL AND MECHANICAL TROUBLESHOOTING

Warning

Electrical hazard. Please study the electrical circuit diagram carefully before you start using this cabinet. You can find the electrical diagram inside the electrical panel which in turn is behind the front panel.

Problem	Possible Causes	(i) Corrective Action
Cabinet does not start	Power failure	Check if there is power at the wall socket If circuit breaker has tripped, please check electrical components and connections before resetting the breaker.
	Wrong electrical connection	Check whether electrical cord has been connected properly
		Check if the SMPS output is 7.5VDC at its output terminal. If no voltage, please check the incoming power supply to the SMPS. If the output voltage of SMPS is less than 7VDC, replace the SMPS
		Check whether there is 7.5VDC supply to the main board. Using multimeter, probe J13 on the main board (terminal nearer to the edge of the board is the negative terminal)
		Check whether there is 7.5VDC supply to the relay board. Using multimeter, probe J1 on the relay board (terminal nearer to the edge is the negative terminal)
	Spoilt Main Board	Restart the cabinet several times. If the following three conditions persist, you should know that the main board is spoilt: 1. All LEDs on the membrane are always off 2. LCD displays nothing 3. No sound from Relay Board **Please replace the main board**
	Spoilt Relay Board	You should know that the relay board is spoilt if you observe the following conditions: 1. Main Board is working properly 2. FRC cable between main board and relay board is properly installed 3. All the connectors and fuses have also been connected properly and are in good working condition 4. However neither amongst FAN, LIGHT or SOCKET can be controlled **Please replace the relay board**.

Motor is silent	Fan is Off	Please switch on the FAN by pressing the FAN button. Enter the FAN PIN if required. The green LED above the FAN button will illuminate.
	Blown fuse	• Switch off the cabinet. • Check for fuse F1 on the relay board. If the fuse has blown, replace it with a new one. Temporary solution: take out fuse F5 and put it in place of F1.
	Faulty relays	1. Switch off the cabinet. 8. Check LS1 relay on the relay board. Ensure that C-NC connection is closed and C-NO open. 9. Check K1 relay mounted on the electrical box. Ensure that C-NC connection is closed and C-NO open. 10. Replace the faulty relay(s).
	Faulty speed control	• Short out the control by connecting a jumper wire across the leads of the two speeds control. • If the fan operates properly, you can conclude that the speed control is defective. Call your distributor for replacement. • If the fan does not operate, the problem is not with the speed control.
	Auto-thermal cut-off (built-in)	1. Overheated Blower. 2. Wait for 30 minutes and try again. Ensure that no hazardous materials are there inside the cabinet. 3. Replace blower if problem persists.
	Motor failure	1. Disconnect the two motor leads and connect an AC voltage source directly to the motor. 2. If the motor starts to run, the problem is in the wiring. Refer to blown fuse or faulty relay sections. 3. If the motor does not run, the motor is defective. Replace the motor.
	No airflow, burning smell and possibly a humming noise too → Faulty capacitor	Disconnect and measure the capacitance, replace faulty capacitor.
Blank LCD	Connection problem	Check whether LCD FRC connector has been inserted properly into its socket on the main board.
	Contrast problem	Adjust the potential meter (next to the connector to Relay Board) on main board to achieve the best contrast.
	Spoiled LCD	Connect a working LCD to the LCD port of main board. If the working LCD functions properly, you should know that the old one is spoilt. Replace the old one.
Inoperative buttons	Connection problem	1. Check if the green plastic cable from the keypad has been inserted properly into the interface board. 2. Check if the interface board has been connected to the main board through a FRC connector. The triangle sign on the female connector indicates that PIN is corresponding to PIN 1 of male connector.
	Spoiled Cable and / or Interface Board and / or keypad	Replace them one by one, to check which one(s) amongst them is/are spoilt. Replace the spoilt one(s) with one(s) that are new/working.

Airflow Failure - alarm is triggered (this could be due to either hardware or software)	Low or High building supply voltage	• Using multimeter, probe the motor voltage sampling port as described in the re-certification section of this manual. This is to measure the blower's supply voltage. • If the supply voltage is lower than the test report value, adjust the speed control to get blower output voltage as specified in the Test Report – Test Conditions Documentation Sheet
	Fluctuating Voltage	If the building supply voltage fluctuates more than the stated tolerance (+/- 2%), connect the cabinet to a voltage stabilizer.
	Sensor Failure / Sensor Misalignment	<u>Air Flow Sensor failure / misalignment</u> 1. Check the sensor connection. 2. **Important:** Ensure that the sensor is not blocked at all and that its through-hole is perpendicular to the filter's surface. Check also if sensor is moved from its original position 3. Using multimeter, check the sensor's output voltage at channel AIN1 and J1. The voltage should increase with increase in airflow. Replace the sensor if your observation is otherwise. 4. Call your distributor if the problem is still not solved <u>Temperature Sensor Failure</u> 1. Check the sensor connection 2. Using multimeter, check the sensor's output voltage at channel AIN4 and J4. 0.01V should represent one degree Celsius. Replace temperature sensor if your observation is otherwise. <u>Chemical Sensor Failure*</u> 1. Check the sensor connections. 2. Using multimeter, check the sensor's input voltage supplied by the Main-Board at the Buzzer Pad. It should be approximately +5V DC. If no voltage is supplied, verify a jumper connection to pins 1 and 2 at J7. If such jumper is connected and the voltage reading is different from +5V DC, replace the main board. 3. Using multimeter, check the sensor's output voltage at channel AIN2 and J2. Verify equality between multimeter voltage reading and the Chemical Sensor voltage reading under Maintenance mode, displayed on the LCD. If values are not equal, replace the main board. ** = Only for ADC with VOC sensor*
	Motor failure	Check the motor. Refer to 'motor silent' section
	Filter loaded	Plug in the multimeter to the Motor Voltage Sampling Port. Turn the Speed Control to increase the blower voltage by approximately 10 volts until the alarm is turned off and the LCD shows nominal airflow reading. The sensor will take about 1-2 minutes before it can register a new airflow setting. **Note: The cabinet must be certified at least annually.** If the blower is already operating at maximum voltage and the airflow alarm is triggered, it's time to change the filter.
	Faulty/ inaccurate calibration	Re-calibrate the microprocessor. WARNING: To be carried out only by an authorized person.
	Others	Please refer to software troubleshooting section for more information.
Excessive fan noise	Loose motor or impeller wheel mounting	1. Check if the screw holding the impeller has been fully tightened. 2. Check if all the impeller and motor mounting bolts have been fully tightened. 3. Check the capacitor, and replace if necessary.

Light always OFF	Faulty relay	Check LS7 relay and fuse F7 on the relay board. Replace the fuse if it has blown. Ensure that C-NC connection is closed and C-NO open. Replace the faulty relay board. Call your distributor for details.
	Connection Problem	1. Check the connection between relay board, fluorescent lamp ballast and female connector at the side of the electrical box. 2. Check the connection of the lamp holder.
	Faulty light	Replace the faulty light.
	Light is off	Please switch on the LIGHT button by pressing the LIGHT button. The blue LED above the LIGHT button will illuminate
Electrical Socket always OFF	Connection Problem	1. Check the connection between relay board and female connector at the side of the electrical box. 2. Check the connection of the socket
	Faulty electrical socket	Replace the electrical socket
	Faulty relay	Check LS4 relay and fuse F4 on the relay board. Replace the fuse if it has blown. Ensure that C-NC connection is closed and C-NO open. Replace the faulty relay board. Call your distributor for details
	Socket is off	Please switch on the SOCKET button by pressing the SOCKET button. The blue LED above the SOCKET button will illuminate

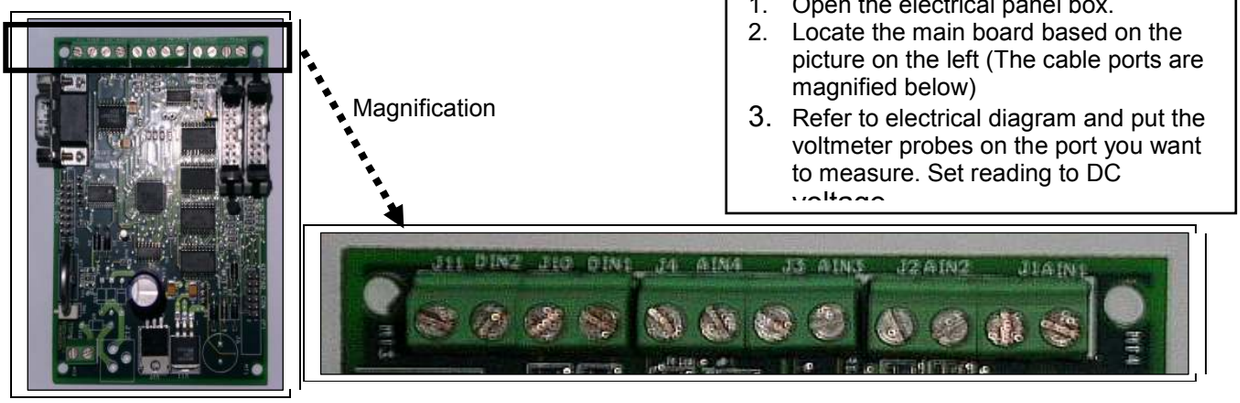
ADDITIONAL NOTES ON AIRFLOW ISSUE DUE TO SUPPLY VOLTAGE AND FREQUENCY

Where the actual supply voltage or frequency on site differs from test conditions at the Esco factory, small deviations *within the allowed operating conditions (blower voltage difference of not exceeding 2%)* will not have any detrimental effect on the cabinet's performance and thus the user need not necessarily re-adjust the speed control. However the user can still compensate for any such difference in the following ways:

a. If the cabinet is brand-new, the filter unused (clean filter) and the on-site supply frequency same as what was recorded above, then the user can re-adjust the speed control to ensure that the motor voltage (measured with a voltmeter) corresponds to the value recorded in Test Report – Test Conditions Documentation Sheet

b. If the cabinet has been used for some time (filter starts to get loaded with particles), or if supply frequency and/or supply voltage differ from the values recorded in the Test Report, then the user may adjust the speed control until the LCD displays the optimum airflow as indicated in the Test Report – Sentinel™ Calibration Sheet. Note that the Esco Sentinel™ system should be allowed to "warm-up" for at least 10 minutes before the speed control adjustments are made.

Checking the Sensor Output



1. Open the electrical panel box.
2. Locate the main board based on the picture on the left (The cable ports are magnified below)
3. Refer to electrical diagram and put the voltmeter probes on the port you want to measure. Set reading to DC voltage

4.2 SOFTWARE TROUBLESHOOTING

Error Codes	Explanation	Corrective Action
AIRFAIL	If airflow sensor output voltage exceeds the calibrated minimum or maximum point, AIRFAIL alarm will be triggered	1. Check the real inflow velocity using anemometer If the inflow has indeed exceed the calibrated minimum or maximum point (see Calibration Section for the exact value), adjust the speed control to achieve blower output voltage as stated in the Calibration Certificate. WARNING: This step should be carried out only by an authorized person 2. If real inflow velocity is very close to the minimum point or maximum point, adjust speed controller to achieve the blower output voltage for nominal point as stated in the Calibration Certificate. 3. Check the calibration and operating data a. Press menu and key in ADMIN password to switch to MAINTENANCE mode b. Read the airflow velocity displayed on LCD and confirm if it is either below the minimum point or above the maximum point. The fluctuation should be less than 0.02m/s c. Press SET button to read diagnostic message and confirm ADC A/F is either below ADC MIN or above ADC MAX. In normal operation, ADC A/F shall be the mean value of ADC MIN and ADC MAX, and vary by no more than 30 d. Check whether the constant and temperature values are correct. If constant value is incorrect, please check the wire connection and temperature sensor. Call your distributor to replace spoilt parts (if any). WARNING: This step should be carried out only by an authorized person
ERR.CALIB	Controller has not yet been calibrated	Calibrate the controller. Refer to Calibration section for details. WARNING: This step should be carried out only by an authorized person

TEMP HIGH!	If temperature sensor output voltage exceeds set temperature alarm point, TEMP HIGH! Alarm will be triggered.	1. Wait temperature inside the work zone to cool down before continuing with the experiment. 2. Set a higher temperature alarm point **Note: TEMP HIGH! Alarm has higher priority than AIRFAIL alarm but lower priority than SASH alarm**
NEAR SATURATION* (Alarm 1)	If chemical sensor output voltage exceeds the first calibrated maximum point, NEAR SATURATION alarm will be triggered.	This is just a warning to the end-user that the carbon filter is near saturation and that it is time to order a new one. You may choose to ignore this alarm for once. Disable this alarm (A1) by pressing the MENU key. Alarm 2 will be triggered if it is enabled (the default status) and the chemical concentration continues to increase to an unsafe level.
STOP EXPERIMENT!* (Alarm 2)	If chemical sensor output voltage exceeds the second calibrated maximum point, STOP EXPERIMENT! alarm will be triggered.	This shows that the carbon filter has reached its maximum adsorption capacity. It would be dangerous to continue operation in the ductless cabinet. Disable this alarm (A2) by pressing the MENU key. Change to a new filter now. Please note that current status of Alarm 1 is disabled and Alarm 2 is set at 3.75V. Enable both alarms (A1 and A2) at the option in the sensor menu. The alarm will be triggered again when chemical sensor output voltage exceeds.

**** = Only for ADC with VOC sensor***

3.3 MOTORISED SASH WINDOW TROUBLESHOOTING

If you encounter any problem in operating the motorized sash window, kindly refer to the troubleshooting guidelines provided in this section. In the event of the motor malfunctioning, you would most likely see the “SASH MOVING…” message being displayed even though the sash window would not be moving. In such a scenario, follow the guidelines stated below:

1. Open the sash profile and check the state of the magnetic switch and the magnet installed on the sash window. Use the magnet to enable the switches, and while you are doing that, also check the corresponding diagnostic messages in maintenance mode.

2. Check that the relay board is properly powered up and that there is no problem in the connection between relay and main board (Refer to the troubleshooting guide)

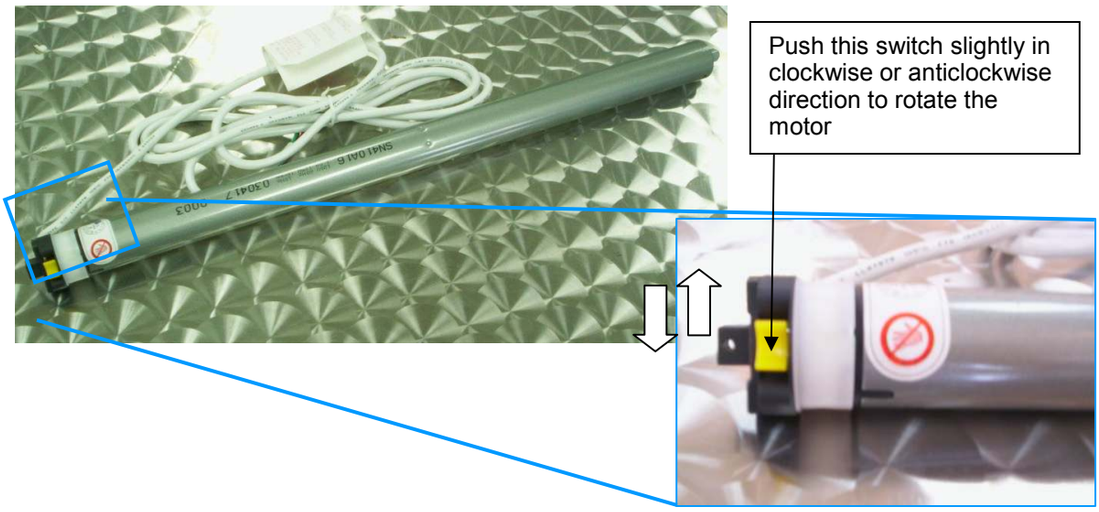
3. Check that fuse F3 (for motor UP control) and fuse F6 (for motor DOWN control) on the relay board are in good working condition. If either of the fuses has blown, replace it.

4. On pressing the UP button, check if two wires at J5 connector on the relay board are short. Similarly, on pressing the DOWN button, check if two wires at J11 connector are short. If you fail to observe these conditions, check if the pair of wires at the two connectors are properly connected to their respective ‘Common’ and ‘Normal Open’ (N/O) points. Refer to the electrical circuit diagram for better understanding. If the wires are still found NOT to be short, replace the relay board. Otherwise go to step 5.

5. Refer to electrical diagram and check if there is any problem with any of the connections to the motor. If there is no problem with the connections, check if the motor settings for the highest and lowest points are proper. Instructions on how to do the highest and lowest point settings for the motor has been discussed in the next section

HIGHEST AND LOWEST POINT SETTINGS FOR THE MOTOR

We have already discussed that at the time of adjusting the sash window position using the UP and DOWN buttons, the motor would automatically stop whenever the sash window reaches its normal operating height. The control system can detect the position of the sash window on the basis of the states of the magnetic switches. On top of this, there are settings in the motor itself to detect the fully open and fully closed positions of the sash window on its own. These two settings helps safeguard against the eventuality of the sash window not stopping on reaching the fully open or fully closed positions.



These two settings are done for the motor in the factory before the units are shipped. However, at any time, if you observe that the motor is stopping before the sash window can reach the fully open position or the motor fails to stop once the sash window reaches the fully closed position, you would need to re-do these two motor settings. Before going into the details of how to re-do the settings, the motor needs to be studied in greater details. As can be seen in the picture above, the motor has a yellow switch on one end. Pushing the switch slightly in clockwise and anti-clockwise direction (as indicated by the arrows) would both cause the motor to rotate, but in opposite directions. This would result in the sash window moving up or down.

NB: It is NOT necessary that pushing the switch in the direction indicated by the upward arrow would cause the sash window to move upwards and pushing it in the direction of downward arrow would result in the sash window moving downwards. The relationship between the direction in which the switch is pushed and the resultant direction of sash window movement varies from unit to unit depending on the orientation of the switch after the motor is mounted on the cabinet. Users are therefore recommended that before they re-do the motor settings, they push the switch in both directions and observe the resulting direction in which the sash window moves.

Follow the steps stated below for re-doing the settings:
NB: Two persons would be needs to re-do the settings

1. Firstly raise the front panel of the cabinet so that you can access the motor.
2. To re-do the settings for the fully-open position, one person should press the UP button on the Sentinel® control system, while the other person would have to push the yellow switch in the direction that causes the sash window to move upwards. The switch and UP button should be released at the instant when the sash window reaches the correct fully-open position.
3. Similarly, for re-doing the settings for the fully-closed position, one person should press the DOWN button on the Sentinel® control system, while the other person would have to push the yellow switch in the direction that causes the sash window to move downwards. The switch and DOWN button should be released at the instant when the sash window reaches the correct fully-closed position.

REPLACEMENT PARTS

There are two changes in the replacement part list of a corresponding model with motorized window.

1. First of course, there is an additional motor which drives the sash window. Its component code is **EQR/ME-MOTOR-TBR**.

2. Secondly, the models with a motorized window make use of a different relay board than that used in the standard models. Kindly take note of the change in the table below:

	Standard Models	Models with motorized sash window
Relay Board Component Code	EQR/EL-MC-02	EQR/EL-MC-02A

The main difference between these two relay boards is that the EQR/EL-MC-02A (relay board of the models with motorized sash window) has two more relays (LS3 and LS6) installed on it. These two relays are used to control the UP and DOWN functions respectively.

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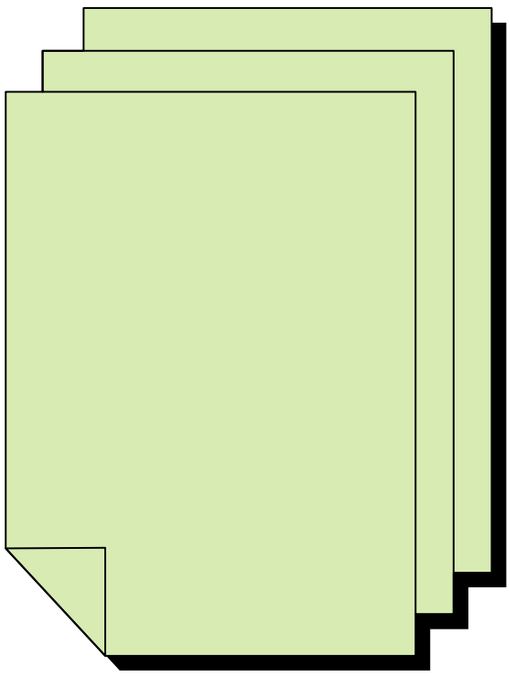

APPENDIX

APPENDIX A
FILTER SATURATION TEST

SECTION A: INTRODUCTION

Electronic detectors for monitoring filter saturation (efficiency) have not been shown to be sufficiently reliable for the range of gases used in school/lab and over a reasonable time scale; therefore chemical tests are needed.

As there are strict limits to the concentrations of hazardous gases in air which can be breathed, it is necessary to test the efficient of the filter regularly. Further, it is prudent to conduct an initial test to ensure that the filter is seated properly and that its contents have not been displaced in transit. It is advisable to test for this every time the filter is replaced.

There are 3 methods according to the COSHH regulation to test for filter saturation by chemical (acid gases). There are namely:-

- Propan-2-ol challenge test (BS 7989:2001 Standard)
- Method using a canister (cease to be practicable)
- Method using the burning sulphur (BS 7989:2001 Standard)
- Test for saturation by organic gases (limited usage)

For our purpose, Esco will be using the propan-2-ol challenge and burning sulphur test method.

SECTION B: PROPAN-2-OL CHALLENGE TEST

The filter, when challenged continuously at 800 ppm +/- 50 ppm of propan-2-ol, shall maintain the concentration of propan-2-ol in the exhaust stream at below 40 ppm throughout the period of evaporation of 1 liter of propan-2-ol and below 400 ppm throughout the period of evaporation of 2 liter of propan-2-ol.

The rate of release of propan-2-ol vapor is calculated by evaporating a weighted quantity of propan-2-ol for a measured time. The filter challenge concentration and filter efficient are then calculated as shown.

B.1 APPARATUS

1. Gas detection kit
2. Propan-2-ol
3. Anti-bumping granules
4. Balance, weighting to 0.1 gram or less
5. Stop clock
6. 250 ml conical flask, with a stopper.
7. Hotplate

B.2 PROCEDURE

1. Determine the air volume flow rate through the fume cupboard and record the value as F_a in m^3/min.

2. Pour about 100 ml of propan-2-ol into a preweighted, stoppered, conical flask containing a few anti-bump granules. Record the weight of solvent added as M_1 in gram.

3. Set up the hotplate in the fume cupboard. Switch on the fume cupboard, remove the stopper from the flask and place the flask in on the hotplate.

4. As the propan-2-ol beings to boils, the vapour condenses on the cooler parts of the flask forming a boundary line. When the boundary reaches the top of the flask, start the stop clock.

5. After 60s, take a reading of the concentration of propan-2-ol in the exhaust gas emitted by the fume

cupboard using a gas detection kit with a suitable tube. Repeat the measurement at 5 min. record the highest concentration in ppm. Convert the concentration from ppm to mg/m^3 using the formula below and record as C_e in mg/m3.

6. When the last of the propan-2-ol has evaporated stop the clock, noting the time of the run as t in second.

B.3 CALCULATION

Calculate the total volume V_a in m^3 of air passed through the fume cupboard during the test as follows:

$V_a = F_a\ t / 60$

Caculate the challenge concentration in mg/m^3:

$C_o = 1000\ M_1 / V_a$

Calculate the filter efficiency (%):

Filter efficiency = $100\ (C_o - C_e) / C_o$

Conversion from ppm to mg/m^3:

Concentration in mg/m^3 = Concentration in ppm x 60.1 / 24

APPENDIX B
MEASUREMENTS OF FACE VELOCITY TEST

Note: Do note that our factory face velocity test provided in our test report is based upon the ASHRAE standard which uses more extensive equipments. The following face velocity test however is based upon the COSHH (HSE) which is provided here for your general on-site testing. Please consult your distibutor if you which to conduct the face velocity test based upon the ASHRAE standards.

SECTION A: PROCEDURE

1. Do not attempt measurements on a windy day. It is best if doors are not being opened and shut elsewhere in the building.
2. Arrange the ventilation of the room so that it is most unfavorable to extraction by the fume cupboard concerned
3. Remove everything from the fume cupboard so that the air flow is not obstructed by objects.
4. Do some quick air flow measurements to see if, with the sash at maximum height, the minimum face velocity is likely to be over 0.3 ms^{-1}. Set the sash to its normal operating height.
5. Record this sash height.
6. Imagine the face of the fume cupboard divided into nine equal rectangles. Stand as far as practicable from the fume cupboard with the sensing heading in the plane of the sash and take air flow reading at approximately the centre of the nine rectangles.

a	b	c
d	e	f
g	h	i

1. Record for each rectangle the approximately average reading over a period of at least ten seconds.
2. Look at the table and repeat any reading which seems to be very difference from the general pattern. Record the average of this and the previous reading.

SECTION B: CALCULATION

Minimum face velocity
Record which of **a, b, c, d, e, f, g, h, i** is the smallest
Is the value above or below 0.3 ms^{-1}? If it is below, the fume cupboard fails.

Variation
Add **a, b, c, d, e, f, g, h, i,** and divide by 9 to get the average.
Find the biggest and smallest value of **a, b, c, d, e, f, g, h, i**.

Calculation: Biggest minus average. Divide the answer by average and multiply by 100 to obtain the lower percentage variation.

Is each of these less than 30%? If not, the fume cupboard does not meet the recommendation and, if a new installation, should not be accepted.

The variation in favourable conditions should be below +/- 20%. However, because it is difficult to find ideal sites in many laboratories, +/- 30% has been stipulated.

APPENDIX C

ESTIMATED CARBON CAPACITIES FOR CONTAMINANT

This section is provided to present a list giving estimated activated carbon capacities for contaminant vapours. The adsorption capacity of activated carbon for the various vapours varies with:

- concentration,
- humidity and temperature,
- actual velocity used through the filters,
- contact time,
- particle size of the activated carbon,
- diffusion coefficient of the constituent(s) to be adsorbed,
- distribution of the pore sizes of the activated carbon.

The numbers given in the list represent typical or average conditions, presuming that a good pre filtration has removed liquid and/or solid impurities which could also be present in the gas/air to be cleaned. The given capacities are equilibrium capacities. In fixed bed adsorbers, the effective capacity could be somewhat lower due to the mass transfer zone (MTZ) in the activated carbon bed. This MTZ is influenced by the type of activated carbon, the process conditions and the required removal efficiency.

ADSORPTION CAPACITY INDEX

Capacity Index	Meaning
High capacity (1)	One kilogram carbon takes up about 20 to 50 w/w % of its own weight. Average capacity around 35 w/w %
Satisfactory capacity (2)	The adsorption capacity for components in this category is between 10 to 25 w/w % with an average of 16 w/w %
Moderate capacity (3)	The adsorption capacity is low but might be sufficient under particular conditions
Low capacity (4)	For the substances in this category the adsorption capacity is that low that activated carbon can hardly be used. In some applications a special impregnated activated carbon might lead to satisfactory results

Impregnation of activated carbon is used to increase the capacity for some gases, such as mercury, hydrogensulphide, acid gases, ammonia, etc. The components marked in the list with an asterisk can be removed by useof an impregnated carbon. Combination of impregnated and non impregnated carbons can solve cases in which various components have to be removed.

RELATIVE CAPACITY OF GRANULAR ACTIVATED CARBON FOR VARIOUS CONTAMINANT VAPOURS

Acetaldehyde	3	Freon 113	1
Acetic acid	2	Fumes	2
Acetic anhydride	1	Gasoline	1
Acetone	2	Heptane	1
Acetonitrile	3	Heptylene	1
Acetylene	3	Hexane	2
Acrolein	2	Hexanol	1
Acrylic acid	1	Hexanone	1
Acrylonitrile	1	Hexene	2
Adhesives	1	Hexyne	2
Allyl chloride	1	Hospital odours	1
* Amines	3	* Hydrogen	4
* Ammonia	4	* Hydrogen bromide	3
Amyl acetate	1	* Hydrogen chloride	3
Amyl alcohol	1	* Hydrogen cyanide	4
Amyl ether	1	* Hydrogen fluoride	3
Aniline	1	* Hydrogen iodide	2
Antiseptics	1	* Hydrogen selenide	3
Asphalt fumes	1	* Hydrogen sulphide	2
Benzene	1	Ide	1
Blood odour	2	Iodine	1
Body odour	1	Iodoform	1
Bromine	1	Isopropyl acetate	1
Butadiene	2	Isopropyl alcohol	1
Butane	3	Isopropyl chloride	1
Butanone	1	Isopropyl ether	1
Butyl acetate	1	Kerosene	1
Butyl alcohol	1	Ketone	1
Butyl cellosolve	1	Kitchen odours	1
Butyl chloride	1	Krypton delay	1
Butyl ether	1	Lactic acid	1
Butylene	3	Liquid fuels	1
Butyraldehyde	2	Liquor odours	1
Butyric acid	1	Lubricating oils and greases	1
Camphor	1	Lysol	1
Caprylic acid	1	Menthol	1
Carbolic acid	1	Mercaptans (large molecule)	1
Carbon dioxide	3	* Mercury vapours	4
Carbon disulphide	1	Mesityl oxide	1
Carbon monoxide	4	Methane	4
Carbon tetrachloride	1	Methyl acetate	2
Cellosolve acetate	1	Methyl acrylate	1
Chlorine	2	Methyl alcohol	2
Chlorobenzene	1	Methyl bromide	2
Chlorobutadiene	1	Methyl butyl ketone	1
Chloroform	1	Methyl cellosolve	1
Chloromethane	2	Methyl cellosolve acetate	1
Chloronitropropane	1	Methyl chloride	2
Chloropicrin	1	Methyl chloroform	1
Cigarette smoke	1	Methyl cyclohexane	1
Citrus and other fruits	1	Methyl cyclohexanol	1
Cleaning compounds	1	Methyl cyclohexanone	1
Combustion odours	2	Methyl ether	2

* Corrosive gases	3	Methyl ethyl ketone	1
Creosote	1	Methyl formate	2
Cresol	1	Methyl glycol	1
Cyclohexane	1	Methyl isobutyl ketone	1
Cyclohexanol	1	* Methyl mercaptan	3
Cyclohexanone	1	Methyl methacrylate ester	1
Cyclohexene	1	Methylene chloride	1
Dead animals	1	Monochlorobenzene	1
Decane	1	Monofluorotrichloromethane	1
Detergents	1	Naphtha	1
Dibromoethane	1	Naphthalene	1
Dichlorobenzene	1	Nicotine	1
Dichlorodifluoromethane	1	Nitric acid	3
Dichloroethane	1	Nitro benzenes	1
Dichloroethylene	1	Nitro ethane	1
Dichloroethyl ether	1	Nitro propane	1
Dichloromonofluoromethane	2	Nitro toluene	1
Dichloronitroethane	1	Nitrogen dioxide	3
Dichloropropane	1	Nitroglycerine	1
Dichlorotetrafluoroethane	1	Nitromethane	2
Dicyclopentadiene	1	Nonane	1
Diesel fumes	1	Octane	1
Diethyl ketone	1	Octene	1
Dimethyl aniline	1	Ozone	1
Dimethyl sulphate	1	Palmitic acid	1
Dimethyl sulphide	2	Paper deteriorations	1
Dioxane	1	Para-dichloro benzene	2
Dipropyl ketone	1	Pentane	2
Epichlorohydrin	1	Pentanone	1
Ethane	4	Pentylene	2
Ether	2	Pentyne	2
Ethyl acetate	1	Perchloroethylene	1
Ethyl acrylate	1	Pesticides	1
Ethyl alcohol	2	Phenol	1
Ethyl benzene	1	Phosgene	2
Ethyl bromide	1	* Poison gases	1
Ethyl chloride	2	Propane	3
Ethyl formate	2	Propionaldehyde	2
* Ethyl mercaptan	2	Propionic acid	1
Ethyl silicate	1	Propyl acetate	1
Ethylene	4	Propyl alcohol	1
Ethylene chlorohydrin	1	Propyl chloride	1
Ethylene dichloride	1	Propyl ether	1
Ethylene oxide	3	Propyl mercaptan	1
Fertilizer	1	Ripening fruits	3
Fish odours	1	Rubber	2
Food aromas	1	* Sewer odours	2
* Formic acid	3	Slaughtering odours	2
Freon 11	1	Styrene monomer	1
Freon 12	1	* Sulphur dioxide	3

*Adsorption capacities may be increased by the use of impregnated activated carbon

APPENDIX D
REFERENCE MATERIALS

DUCTLESS FUME TECHNOLOGY

BS 7258-1:1994 Laboratory fume cupboards. – Part 1: Specification for safety and performance.

BS 7258-2:1994 Laboratory fume cupboards. – Part 2: Recommendations for exchange of information and recommendation for installation.

BS 7258-3:1994 Laboratory fume cupboards. – Part 3: Recommendations for selection, use and maintenance.

BS 7258-4:1994 Laboratory fume cupboards. – Part 4: Method for determination of the containment value of a laboratory fume cupboard.

WEBSITES

1. http://www.acgih.org/
   American Conference of Governmental Industrial Hygienists (ACGIH)

2. www.escoglobal.com
   Esco Micro Pte. Ltd.

4. http://www.cdc.gov/niosh/homepage.html
   National Institute for Occupational Safety and Health (NIOSH)

5. http://www.osha.gov
   Occupational Safety and Health Administration, USA

6. https://www.aiha.org/
   The American Industrial Hygiene Association (AIHA)

DEFECT REPORTING FORM

To submit your warranty claim or to obtain a Return Authorization (RA) number, please complete this defect reporting form and return it to Esco by fax or postal mail.

PRODUCT INFORMATION

Model Number : _____

Serial Number : _____

Date of Purchase : _____

CUSTOMER INFORMATION

Company : _____

Address : _____

: _____

Telephone : _____

Fax : _____

Email : _____

NAME OF ESCO DISTRIBUTOR

Contact : _____

Company : _____

Country : _____

BRIEF DESCRIPTION OF ERROR

_____

_____

_____

_____

WHEN DID THE ERROR OCCUR*

Transport Damage / Unpacking / Assembly / Routine Operation

RETURNING PRODUCTS/PARTS*

Under Warranty / For Service or Repair / For Replacement / Credit Note Requested

Name/Date: _____ Signature: _____

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